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DIVISION OF AGRICULTURAL SCIENCES
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ECONOMIC ASPECTS OF PRODUCING AND MARKETING CALIFORNIA APPLES

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FOREWORD

California apple producers are facing many of the same problems as other agricultural producers. These problems include rapidly increasing costs of production and increased competition in product markets from other producing areas. California producers decided to do something about their problems and in the fall of 1967 voted to accept a state-wide marketing order for California apples. Their principal objective is to increase grower returns through promotion of apples and apple products as well as through research on methods to increase production and marketing efficiency. It became apparent during the hearings for the marketing order that information on economic aspects of the California apple industry was scattered and not readily available to people in the industry. The purpose of this paper is to assemble and present economic data describing the present industry situation. These data are analyzed to explain trends in consumption, prices, and production. Quantitative relationships developed in the analysis are utilized to develop alternative forecasts of California apple production and prices in 1980. Areas in which further research may increase marketing efficiency are summarized.

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ECONOMIC ASPECTS OF PRODUCING AND MARKETING CALIFORNIA APPLES

by

Hoy F. Carman* and David E. Kenyon**

INTRODUCTION

Apple production in the United States is widely dispersed. However, because of climate, geography, and profitability of alternative crops, production is concentrated in six major apple producing states. Of these, California, with approximately 8 percent of total U.S. production, usually ranks fourth following Washington, New York, and Michigan. Production from these four states, combined with Virginia and Pennsylvania, account for 70 percent of total U.S. apple production.

United States apple production increased approximately 19 percent from the 1948-1957 period to the 1958-1967 period (Table 1). California's increase in production was slightly above the U.S. average but lagged behind the increases of Michigan, New York, and Pennsylvania. Michigan's increase of 70.6 percent was the largest percentage increase but New York had the largest bushel increase. Washington's production increased only 0.4 percent with the result that its share of U.S. production dropped from 23.8 percent to 20.0 percent. Washington, however, with increased tree plantings during the last 10 years and with 33-million bushel crops in 1963 and 1966, has the potential to sharply increase its average production. A recent study predicted modest production gains in the Eastern and Central states and a very large expansion in the Western states [2, p. 17]. The West is expected to expand from about one-third of all production to 41.4 percent of the national crop in 1975 [2, p. 17].

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TABLE 1

Average Production of Apples in the Six Leading Apple Producing States, 1948-1957 and 1958-1967

State	1948-1957 average	1958-1967 average	Change		U.S. production 1958-1967
			Actual	Percent	
	1,000 bushels[a]				percent
Washington	25,106	25,212	106	0.4	20.0
New York	15,425	21,540	6,115	39.6	17.1
Michigan	8,043	13,726	5,683	70.6	10.9
California	8,250	9,865	1,615	19.6	7.8
Virginia	9,009	9,535	526	5.8	7.6
Pennsylvania	6,004	8,958	2,954	49.2	7.1
Other states	33,786	37,160	3,374	10.0	29.5
TOTAL	105,623	126,003	20,380	19.3	100.0

a/ Any conversion from pounds to bushels and vice-versa is made on the basis of a 48-pound bushel.

Source: U.S. Department of Agriculture, Statistical Reporting Service [35].

CALIFORNIA APPLE PRODUCTION

Location

Apples are produced in 48 of California's 58 counties. Three-fourths of the State's bearing acreage, however, is concentrated in the Watsonville area of Santa Cruz County and the Sebastopol area of Sonoma County. Favorable growing conditions in these two areas result in higher yields than the state-wide average, especially in Santa Cruz County. Almost 87 percent of the 1967 apple crop was produced in Santa Cruz and Sonoma counties. The concentration in bearing acreage and production is even greater when adjoining counties are considered. Figure 1 shows the general location of California apple producing areas. Minor apple producing areas in California include the Sierra Foothills, centered in El Dorado County, and Southern California, which consists mainly of San Bernardino and San Diego counties. Both of these areas typically experience lower yields than are found in the Watsonville and Sebastopol areas. Production is profitable, however, since many of the producers are successful in obtaining a premium price through road-side marketing [12].

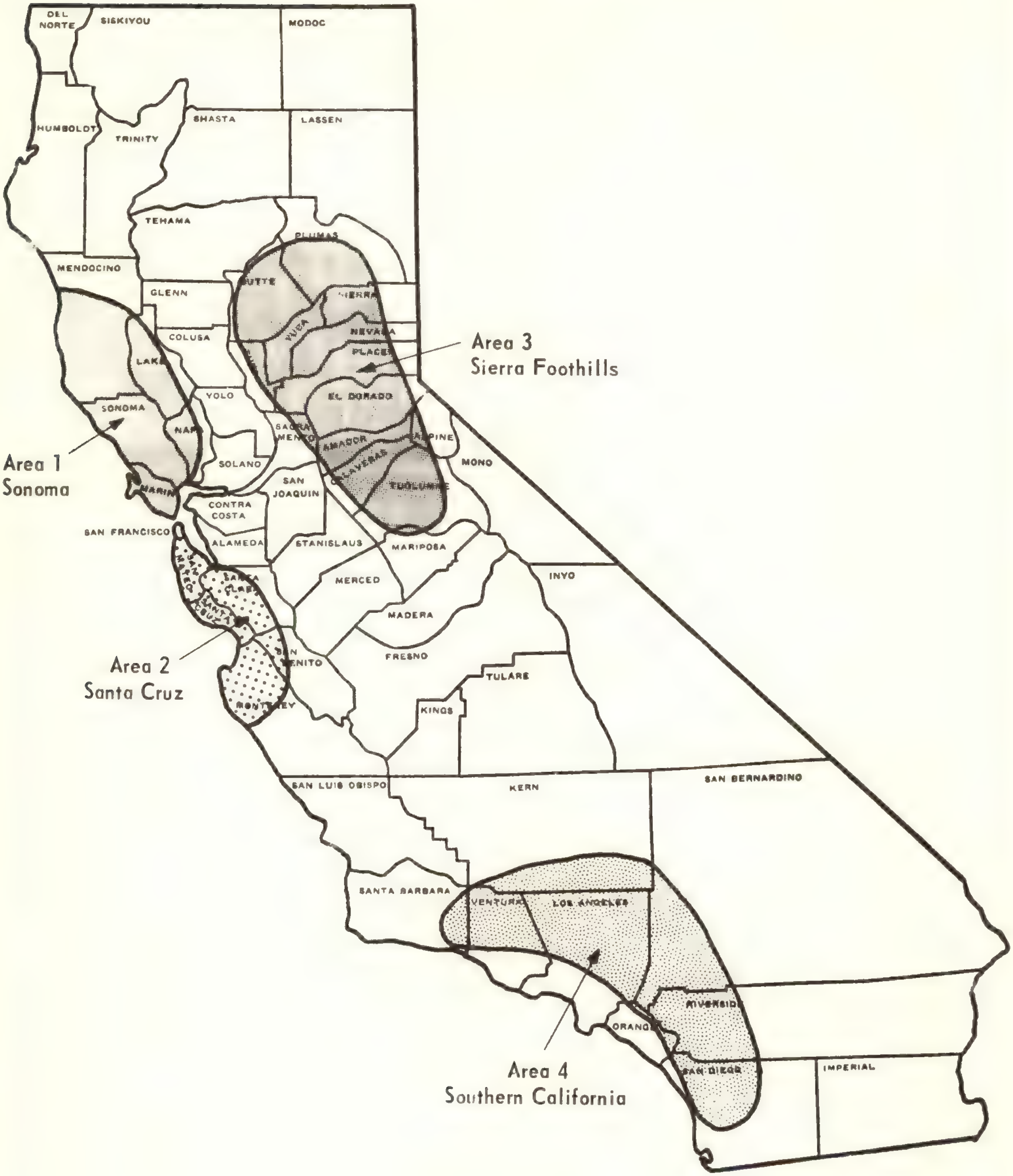
Value of Production

The total farm value of California's 1967 apple crop was slightly less than $13.9 million. This was $1.1 million lower than the 1963-1967 average of $15.01 million [35]. In terms of value of California deciduous tree fruits, apples typically rank fifth. They follow peaches, prunes, pears, and apricots. Apples account for approximately 2.2 percent of the total value of all fruits, grapes, and tree nuts produced in California.

Nationally, the total value of California's apple crop will usually rank in sixth place even though production usually ranks fourth. The average price per pound of California apples is consistently below the U.S. average price, mainly due to the high proportion of the crop utilized for processing. The pricing structure for California apples will be examined in a later section of this report.

FIGURE 1

California Apple Producing Areas



Bearing Acreage

California experienced a 10,699-acre reduction in bearing acreage of apples between 1945 and 1967 (Table 2). El Dorado County was the only major apple producing county to show an increase in bearing acreage. Even with these gains, El Dorado County now accounts for only 2.5 percent of California's bearing acreage. Examination of data in Table 2 reveals some interesting changes. Santa Cruz County's bearing acreage declined 2,020 acres but its percentage share of California acreage increased 5.5 percent to a total of 35.4 percent. Monterey County, the only other county to gain in percentage terms, increased its share of bearing acreage by 0.4 percent. Sonoma County's bearing acreage declined 4,393 acres from 1945-1967 but its share of State acreage dropped only 0.1 percent to 40.6 percent.

The shifts in bearing acreage of apples just described have resulted in a greater concentration of production in the Santa Cruz, Sonoma, and Sierra Foothills areas of California. There are several possible explanations for increased concentration in these areas. They include: (1) the move to commercial production, (2) favorable growing conditions in these areas, (3) profitability of crops competing for apple orchard land, and (4) availability of market outlets for apples.

Nonbearing Acreage

Data on nonbearing apple acreage indicate that California's production will become more concentrated in the Santa Cruz area. Figure 2 illustrates changes in nonbearing acreage by area for the 1947-1967 period. With current nonbearing acreage, one can reasonably expect the concentration in bearing acreage to increase in the Santa Cruz area at the expense of the Sonoma and Sierra Foothills areas. Total bearing acreage will probably increase slightly in the Santa Cruz area, remain fairly constant in the Sierra Foothills area, and decrease in the Sonoma area during the next six to eight years. State wide, bearing apple acreage will probably remain fairly constant for the next six to eight years.

Annual plantings of apples since 1945 have varied from a low of 133 acres in 1952 to a high of 796 acres in 1957 [5]. California has had an average annual planting of 669 acres since 1957. Barring unusual removals, this

TABLE 2

Bearing Acreage: Percentage Distribution and Changes by Major Apple Producing Counties, California, 1945-1967[a/]

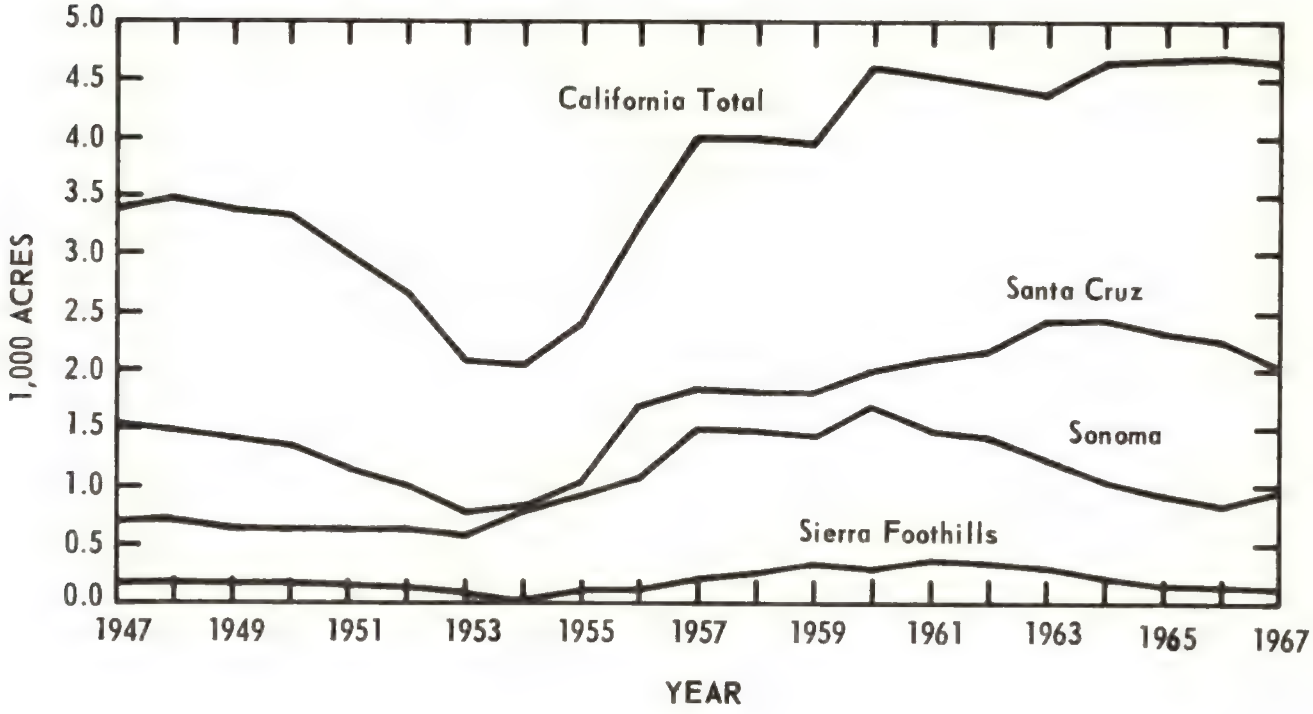
County	Bearing acreage				Change
	1945	1967	1945	1967	
	acres		percent		
Butte	613	350	1.9	1.6	-0.3
El Dorado	276	530	.9	2.5	+1.6
Humboldt	328	0	1.0	0.0	-1.0
Los Angeles	365	0	1.1	0.0	-1.1
Mendocino	1,216	670	3.8	3.1	-0.7
Monterey	773	600	2.4	2.8	+0.4
Napa	620	120	1.9	0.6	-1.3
San Bernardino	758	470	2.4	2.2	-0.4
San Diego	510	350	1.6	1.6	0.0
Santa Clara	313	0	1.0	0.0	-1.0
Santa Cruz	9,610	7,590	29.9	35.4	+5.5
Sonoma	13,103	8,710	40.7	40.6	-0.1
Tulare	438	210	1.4	1.0	-0.4
Tuolumne	498	0	1.5	0.0	-1.5
Other	2,728	1,850	8.5	8.6	+0.1
TOTAL	32,149	21,450	100.0	100.0	

[a/] Major counties are those with 1 or more percent of bearing acreage in the period 1945-1967.

Source: California Department of Agriculture, California Crop and Livestock Reporting Service [6] and [7].

FIGURE 2

Nonbearing Apple Acreage by Producing Regions and Total for State, 1947-1967



rate of planting should be sufficient to maintain California's bearing acreage at a 22,000-acre level for the next six to eight years.[1]

Predicting changes in bearing acreage in the future requires the specification of a supply relationship. This requires an equation to explain the acreage of trees planted each year which will come into production in seven years and another equation to explain the acreage of trees removed from production each year. Total bearing acreage multiplied by average yields gives the expected total supply of apples produced in California.

The acreage of apple trees planted each year depends on several factors with the most important probably being the expected long-run profitability of producing apples in California. Other factors include the expected profitability of alternative crops, the age distribution of existing trees, and the combined effect of other minor factors. Data concerning these factors were examined with the objective of developing an equation to forecast the acreage of apple trees planted in a given year.[2] Consistent data on the proportion of apple trees over 30 years of age are not available. The age distribution of California apple trees is reported but the age categories utilized vary each year. No attempt was made to estimate the profitability of alternative crops because of the large number of alternatives available.

Very little is known about the formation of expectations for a period of 20 years or more into the future. The profitability of production during several years just prior to planting, however, seems to have a strong influence on expectations [16, p. 13] and [17, p. 1023]. The measure of profitability of California apple production formulated in this study is a ratio of average total revenue per acre (average price times average yield) to the U.S. Department of Agriculture's Index of Prices Paid by Farmers. To determine the length of the past period on which expectations are based, two-, three-, four-, five-, and six-year averages were tested. The average of the most recent three years gave the best statistical results. The estimated equation for new apple tree plantings in California is[1]

---

[1] Assuming that the average life of an apple tree is 40 years, approximately 3 percent of bearing acreage would have to be planted each year to maintain acreage at a constant level. Bearing acreage has been fluctuating around the 22,000-acre level of the last ten years.

[2] A very good equation was developed by French and Bressler for forecasting the planting of lemon trees [17, pp. 1023-1024]. In their equation, trees planted were a function of the five-year average of net returns per acre during t-1 to t-5. French, in a Michigan study, developed a supply equation for apples with total U.S. production a function of a five-year average of a ratio of prices to costs lagged ten years [16, pp. 15-17].

$$\log Y = -2.0625 + \underset{(.1477)}{.7156} \log \frac{1}{3} \sum_{t-1}^{t-3} X \qquad (1)$$

$$R^2 = .59 \qquad S_y = .0916$$

where

Y = acres of apple trees planted in year t as a percentage of bearing acreage in year t-1 and

X = average total revenue per acre for California apples divided by the U.S. Department of Agriculture's Index of Prices Paid by Farmers.

The standard error of the coefficient is shown in parentheses. The coefficient is significantly different than zero at the 1 percent level. Within the range of observations, this equation states that the ratio of plantings to the previous years' bearing acreage can be expected to increase .7 percent with each 1.0 percent increase in the three-year ratio of average returns per acre to the cost index. R^2, the coefficient of determination, indicates that 59 percent of the variation in Y, new plantings, is explained by X, the measure of profitability of California apple production. S_y is the standard error of estimate.

Apple trees are classified with bearing acreage seven years after being planted. Assuming that no trees are removed before reaching bearing age, Equation (1) can be used to predict additions to bearing acreage seven years in the future. Total bearing acreage in any year is equal to the previous years' bearing acreage plus acres of trees coming into bearing minus acres of trees removed.

Apple trees are removed each year because of age, disease, low production, more profitable alternatives, and real estate development. As previously noted, data for the age distribution of trees and alternative crops are not satisfactory for use in estimating an equation. Data on trees removed for real estate development and urban expansion are not available. Any equation estimated for tree removals will thus contain a "built-in" adjustment for age of trees, disease, alternatives, and real estate development.

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[1] Data utilized in estimating the various equations included in this report are presented in Appendix Tables A-1 and A-2.

An equation to estimate the acres of trees removed was derived using bearing acreage, a profitability measure of producing apples for the most recent three years, price per bushel the previous year, and trend as explanatory variables. The coefficients for the profitability measure and price per bushel were nonsignificant and were dropped from the analysis. The estimated equation for acres of apple trees removed is

$$Y = -15{,}265.47 + \underset{(.183)}{.727}\ X_1 + \underset{(33.06)}{44.456}\ T \tag{2}$$

$$R^2 = .573 \qquad S_y = 48.503$$

where

Y = acres of apple trees removed in year t,

X_1 = bearing acreage of apple trees in California in year t, and

T = time trend with 1952 = 1, 1953 = 2, . . ., 1966 = 15.

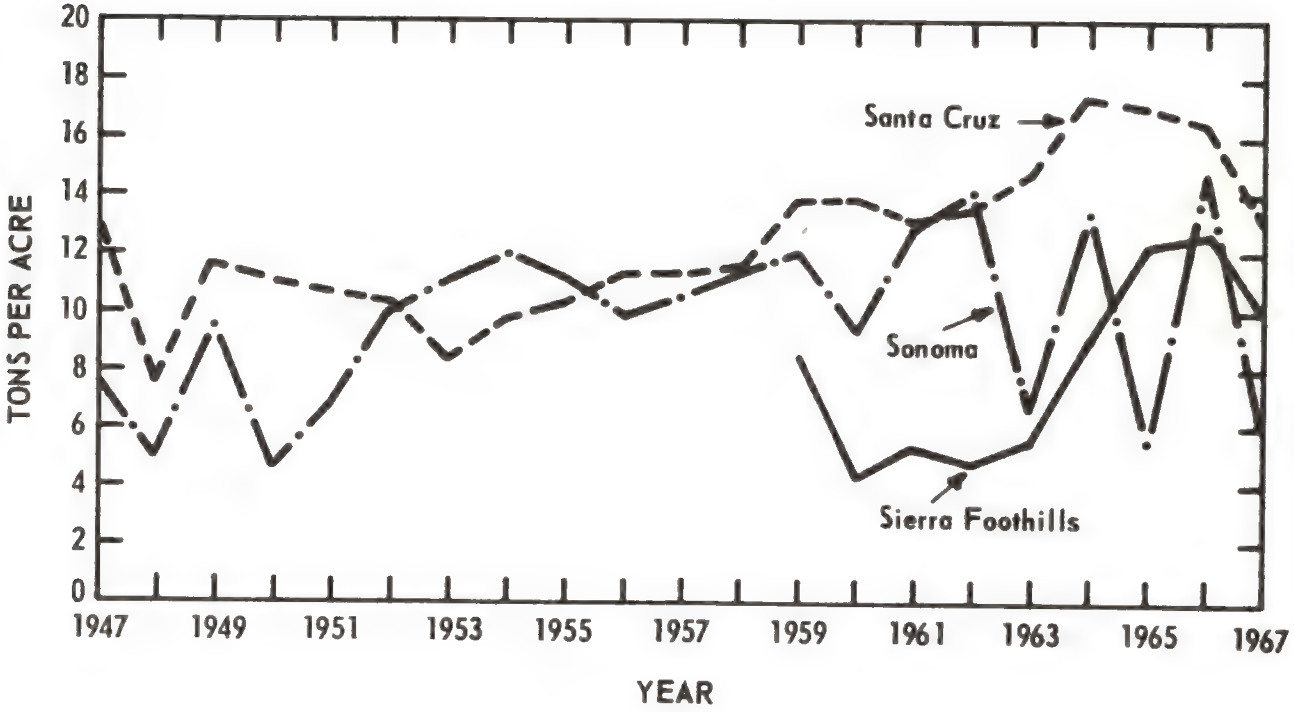
Standard errors of the coefficients are shown in parentheses. The coefficient for bearing acreage was significant at the 5-percent level. The trend variable indicates that apple tree removals are increasing in a uniform manner over time. This reflects a tendency to remove apple trees at an earlier age.

Yields

California has increased total apple production during the last twenty years despite a 33-percent reduction in bearing acreage. This is due to increases in average yields, particularly in the Santa Cruz area (Figure 3). Yields in Santa Cruz County have increased rapidly since 1958, with the average yield for 1963-1967 being 15.7 tons per bearing acre. Yields in the Sierra Foothills area rose to a high of 12.6 tons per bearing acre in 1966. These improved yields are largely due to improved cultural practices, new varieties, and fewer small "backyard" orchards. Sonoma area yields have tended slightly upward over time but have been very erratic, especially since

FIGURE 3

Yield Per Bearing Acre by Production Areas, California, 1947-1967



1959. The 1963-1967 average yield for the Sonoma area was 9.2 tons per bearing acre, with a range in yields from 14.8 tons in 1966 to 5.8 tons in 1967. This variability of yields is largely the result of weather conditions.

The trend in yields for California apples can be estimated quite satisfactorily with the equation

$$Y_i = a + bT$$

where

Y_1 = average yield (bushels per acre) of all California apples,
Y_2 = average yield (bushels per acre) of California Delicious apples,
Y_3 = average yield (bushels per acre) of California apples (varieties other than Delicious), and
T = time trend with 1950 = 1, 1951 = 2, . . . 1967 = 18.

Equations were estimated utilizing a five-year moving average (from t-4 to t) of yields for all varieties, Delicious varieties, and varieties other than Delicious. The equation for all varieties is

$$Y_1 = 258.32 + \underset{(.528)}{12.48}\ T \tag{3}$$

$$R^2 = .972 \qquad S_y = 11.64$$

The standard error for the trend variable is shown in parentheses. The trend variable is highly significant with the five-year average yield of all California apples increasing at a rate of 12.48 bushels per year.

The equation for California Delicious apples is

$$Y_2 = 145.07 + \underset{(.975)}{16.41}\ T \tag{4}$$

$$R^2 = .946 \qquad S_y = 21.46$$

The trend variable is highly significant with the five-year moving average yield of California Delicious apples increasing at a rate of 16.41 bushels per year.

The equation for varieties of apples other than Delicious is

$$Y_3 = 277.40 + \underset{(.665)}{12.567}\ T \qquad (5)$$

$$R^2 = .957 \qquad S_y = 14.65$$

Here again the trend variable is highly significant with the five-year moving average yield of varieties other than Delicious increasing at a rate of 12.567 bushels per year.

Producer Characteristics[1]

There were approximately 1,440 farms producing apples in California in 1966. Those producers with sales of less than 15 tons were classed as non-commercial apple producers. There were 644 producers in this category. They had average sales of 4.6 tons per farm and accounted for 1.2 percent of the 1966 California apple crop. This section will examine the number and size distribution by area of the 796 commercial producers who sold over 15 tons of apples in 1966. These producers sold 98.8 percent of the 1966 crop.

The average commercial apple producer in California sold 307.9 tons of apples in 1966. There was considerable variation in average sales between producing areas. Area 1, the Sonoma area (Figure 1), has the highest average with 378.4 tons per producer. Area 1 also has the most producers (Table 3). As one would expect, production outside the two major and two minor producing areas is very limited and on a small scale.

Apple production in California is comparatively concentrated with respect to producers as well as areas. This is evident from 1966 data on the number and size distribution of producers (Table 4). Concentration of production is shown by the cumulative percentages of producers and their share of total production. We see, for instance, that 7.41 percent of the California producers produced 1,000 or more tons of apples and accounted for 49.44 percent of 1966 commercial production. Going down the columns, we see that 48.24 percent of

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[1] This section is based on unpublished data collected by the California Department of Agriculture, Bureau of Marketing, in connection with the State Apple Marketing Order Referendum conducted during the fall of 1967. Comparable data for previous years are not available.

TABLE 3

Commercial Apple Producers, Number
and Size Distribution by Area
in California, 1966

Area[a]	Number of producers	Average farm production[b]
		tons
1	368	378.4
2	306	287.6
3	59	150.0
4	17	239.4
5	46	106.7
State	796	307.9

[a] See Figure 3 for a description of the areas.

[b] Information on production covers 83 percent of the 1966 tonnage reported by the Statistical Reporting Service, U.S. Department of Agriculture. The data on production by farm was checked for accuracy in connection with the State Apple Marketing Order Referendum. Thus, the data on number of farms, average farm size, and farm-size distribution should be representative of California's conditions.

Source: Unpublished data collected by the California Department of Agriculture in connection with the State Apple Marketing Order Referendum, 1967.

TABLE 4

Percentage Distribution of Number of Producers and Production by Size Categories, California, 1966

Production	Producers	Cumulative producers	Production	Cumulative production
tons	percent			
1,000 and over	7.41	7.41	49.44	49.44
500-1,000	8.42	15.83	19.62	69.06
400- 500	2.89	18.72	4.12	73.18
300- 400	4.90	23.62	5.44	78.62
200- 300	7.91	31.53	6.22	84.84
100- 200	16.71	48.24	7.74	92.58
15- 100	51.76	100.00	7.42	100.00

Source: Unpublished data collected by the California Department of Agriculture in connection with the State Apple Marketing Order Referendum, 1967.

the producers produced 100 tons or more apples and accounted for over 92 percent of commercial production. Conversely, 51.76 percent of the producers were in the 15- to 100-ton category and accounted for less than 8 percent of commercial production.

A comparison of the size distribution of producers by area reveals that production is slightly more concentrated in Area 1 than in Area 2 (Table 5).[1/] A comparison of Tables 4 and 5 shows that state-wide averages of concentration are slightly above Area 2 but below Area 1. In general, production in Areas 3 and 5 is less concentrated while production in Area 4 is more concentrated than the state-wide average.

California Apple Varieties

Many apple varieties are suitable for production in California due to the variation in climate. Three varieties, however, account for over two-thirds of total production. Newtons account for over 28 percent of California apple production, Red Delicious almost 23 percent, and Gravensteins about 18 percent (Table 6). The importance of other varieties, together with changes in the varietal composition of production since 1953, is illustrated in Table 6. The Red Delicious variety registered the most significant increase in proportion of total production. The Golden Delicious, Rome Beauty, and Jonathan varieties also increased their share of production. Even though Winesaps and Newtons registered absolute gains in production, their percentage shares decreased. Other varieties decreased in both absolute and percentage terms.

There is a high degree of varietal specialization in the Sonoma and Santa Cruz areas. Production of Delicious and Newtons is heavily concentrated in the Santa Cruz area while a very high percentage of the Gravensteins, Rome Beautys, and Jonathans are produced in the Sonoma area. The Sierra Foothills area produces small quantities of most varieties grown in California.

Comparisons of data on bearing and nonbearing acreage for 1947, 1957, and 1967 reveal several trends as well as clues to the future variety composition of production (Table 7). As indicated, Red and Golden Delicious varieties now account for 33.5 percent of bearing and 52.7 percent of nonbearing acreage.

[1/] A similar comparison for Areas 3, 4, and 5 cannot be made without revealing the nature of individual operations.

TABLE 5

Cumulative Percentage Distribution of Number of Producers and Production by Size Categories, Areas 1 and 2, California, 1966

Production	Cumulative producers		Cumulative production	
	Area 1	Area 2	Area 1	Area 2
tons	percent			
1,000 and over	10.33	6.21	58.08	40.85
500-1,000	18.48	17.32	74.08	68.08
400- 500	21.74	19.93	77.88	72.04
300- 400	27.44	24.18	83.09	77.12
200- 300	36.41	31.04	88.99	82.89
100- 200	50.54	47.38	94.33	91.35
15- 100	100.00	100.00	100.00	100.00

Source: Unpublished data collected by the California Department of Agriculture in connection with the State Apple Marketing Order Referendum, 1967.

TABLE 6

Distribution of Apple Production by Variety, California, 1949-1953 and 1963-1967

Variety	Average production		Proportion of production		Change
	1949-1953	1963-1967	1949-1953	1963-1967	
	tons		percent		
Newton	58,257	66,910	31.6	28.3	- 3.3
Red Delicious	19,621	53,430	10.6	22.6	+12.6
Gravenstein	53,016	41,712	28.8	17.7	-11.1
Rome Beauty	10,698	25,022	5.8	10.6	+ 4.8
Golden Delicious	[a]	13,360	--	5.7	+ 5.7
Jonathan	5,927	11,308	3.2	4.8	+ 1.6
Winesap	2,578	3,200	1.4	1.3	- 0.1
Other[b]	34,351	21,358	18.6	9.0	- 9.6
TOTAL	184,448	236,300	100.0	100.0	--

[a] Golden Delicious included in Red Delicious in 1949-1953.

[b] Other varieties include Astraham, Bellflower, Permain, Red Gravenstein, R. I. Greening, and Winter Banana.

Source: California Department of Agriculture, California Crop and Livestock Reporting Service [6] and [7].

TABLE 7

Percentage Distribution by Variety of Bearing and Nonbearing Apple Acreage, California, 1947, 1957, and 1967

Variety	Bearing acreage			Nonbearing acreage		
	1947	1957	1967	1947	1957	1967
	percent					
Delicious[a]	9.6	19.0	26.6	56.5	48.0	39.7
Golden Delicious	[b]	3.6	6.9	[b]	12.2	13.0
Gravenstein[c]	30.8	24.9	21.6	1.0	7.6	5.9
Newton	21.7	23.0	19.1	12.0	7.2	15.9
Rome Beauty[d]	5.0	6.3	9.8	7.4	14.1	11.9
Jonathan	3.5	4.7	4.9	3.8	4.3	1.3
Winesap	2.6	2.6	1.7	3.3	0.5	0.4
Other	26.8	15.9	9.4	16.0	6.1	11.9
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0

a/ All Delicious varieties except Golden Delicious.

b/ No acreage reported.

c/ All Gravenstein varieties.

d/ All Rome varieties.

Source: California Department of Agriculture, California Crop and Livestock Reporting Board [5].

Their gain in proportion of bearing acreage over the last 20 years has been at the expense of the Gravenstein, Newton, Winesap, and other varieties. It appears, from nonbearing acreage data, that this trend will continue for several years. Percentage gains by Red and Golden Delicious in the near future will be mainly at the expense of Gravensteins. With varietal specialization by area, this implies that the proportion of California bearing acreage will increase in the Santa Cruz area and decrease in the Sonoma area.

Data on the age distribution of the Delicious, Newton, and Gravenstein varieties help to reinforce the above conclusions. Almost half of the Delicious trees in California are under 14 years old and over half of this number is nonbearing (Table 8). The average age of Delicious orchards increased slightly over the ten-year period from 1957-1966 but they are still much younger than the State average for all orchards. No significant changes have occurred in the age distribution of Gravensteins. Their age distribution continues to be skewed toward the 29 years and older category. Newton orchards have a lower average age than they did in 1957. The proportion of trees under 14 years of age increased 5 percent from 1957-1966 while the proportion over 29 years of age decreased 7.4 percent. As expected, the average age of all varieties has been decreasing. This is primarily due to the recent large plantings of Delicious varieties.

The three major apple varieties produced in California are quite specialized as to use. Gravensteins, once a popular variety for fresh use, are now considered a processing variety. Only about 8 percent of annual Gravenstein production is sold for fresh use. Newtons are also popular as a processing variety but small amounts are sold fresh. The Delicious varieties are best suited for fresh consumption and the majority of the crop goes to this outlet.

Costs of Production

There is significant variation in per acre costs of production between different apple producing areas in California. The majority of this cost variation is due to costs of water, land, labor, spray, and fertilizer. Per acre production costs are highest in Santa Cruz County and lowest in Nevada County (Sierra Foothills area). Profitability of production depends, of course, on yield per acre and price per ton as well as costs per acre. Average yields rank in the same order as costs per acre with Santa Cruz County highest and

TABLE 8

Age Distribution of California Apple Trees by Variety, 1957 and 1966

Age	Variety							
	Delicious		Gravenstein		Newton		All varieties	
	1957	1966	1957	1966	1957	1966	1957	1966
years	percent							
1 - 7[a]	33.0	27.4	5.4	4.6	5.5	14.0	15.6	18.0
8 - 14[b]	30.0	22.2	2.0	7.0	10.3	6.8	16.3	17.6
15 - 21[b]	14.3	21.2	2.4	1.9	7.9	9.4	10.0	14.8
22 - 28[a]	8.2	13.4	5.7	1.6	5.8	6.7	10.4	10.1
29 and over[a]	14.5	15.8	84.5	84.9	70.5	63.1	47.7	39.5

a/ Reported acreage.

b/ Calculated as follows:

An age distribution of trees from 1 to 21 years was constructed by using the highest estimates of new plantings. This was done for the 1930-1966 period. Calculated acreage in the 8- to 14- and 15- to 21-year age groups plus reported acreage over 21 years was subtracted from total bearing acreage to determine removals in the 8- to 21-year age category. From this data, a yearly removal rate was calculated and applied to the 8- to 21-year age category.

Source: Computed from data in [5].

Nevada County lowest (Table 9). Average price per ton is highest in Nevada County and lowest in Sonoma County (Table 9). Here the variation is primarily due to the proportion of the crop which is sold in the higher priced fresh outlet. Prices of California apples are discussed in a later section of this report.

Figure 4 illustrates the relationships between average total costs per ton and tons of apples produced per acre. Also shown are average prices and average yields for the 1962-1966 period. Each average total cost curve includes all cash costs, depreciation, and a 6-percent charge on investment (the average total cost curves, based on data in Table 9, are adjusted to allow for changes in variable costs associated with different yield levels). No charge for management services by the operator is included, thus the net return per ton is for management and risk bearing. The figure shows that the "average" producer made a net return in Santa Cruz and Nevada counties and incurred a net loss in Sonoma County. Figure 4 also demonstrates the importance of and interrelationships between costs, yield, and price. Good cultural practices and management, as well as good market outlets, are necessary for apple production in California to be profitable.

Costs of production per acre were $1,121.88 in Santa Cruz County, $867.34 in Sonoma County, and $735.07 in Nevada County[1/] (Table 9). Dividing these costs by average yields for 1962-1966 results in average costs per ton of $71.14 in Santa Cruz County, $80.31 in Sonoma County, and $83.15 in Nevada County. The average 1962-1966 price was $87.27 in Santa Cruz County, $58.78 in Sonoma County, and $125.18 in Nevada County. Subtracting costs from returns results in a net return of $16.13 per ton in Santa Cruz County, a net loss of -$21.53 per ton in Sonoma County, and a net return of $42.03 per ton in Nevada County.

It appears, with average net losses on the order of $21.53 per ton, that Sonoma County apple producers would be switching to other crops. Bearing acreage of apples has been decreasing but at about the same rate as the overall State average. There are several reasons why acreage has not decreased faster. First, Sonoma area yields are quite variable and producers

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[1/] These costs are based on above average producers using the latest available agricultural practices suited to the particular area. They are based on 40- and 50-acre orchards and thus include no allowance for possible economies of large size.

TABLE 9

Estimated Average Costs and Returns for Producing Apples in Three California Counties, 1966-1967

Item	Santa Cruz	Sonoma	Nevada[a]
		dollars	
All costs/acre[b]	1,121.88	867.34	735.07
Cash costs/acre	812.88	602.58	612.76
All costs/ton[c]	71.14	80.31	83.15
Cash costs/ton	51.55	55.79	69.32
1962-1966 average price/ton[d]	87.27	58.78	125.18
Profit/ton (all costs)	16.13	- 21.53	42.03
Profit/ton (cash costs)	35.72	2.99	55.86
Profit/acre (all costs)	254.37	-232.52	371.55

a/ Nevada County costs were adjusted to 1966 levels through use of the Index of Prices Paid by Farmers. The Index increased 19.6 percent during the period 1957-1966.

b/ These costs do not include a return for the operator's management. The cost figures used here are lower than those published in the sources because of lower average yields and, thus, lower variable costs for harvesting.

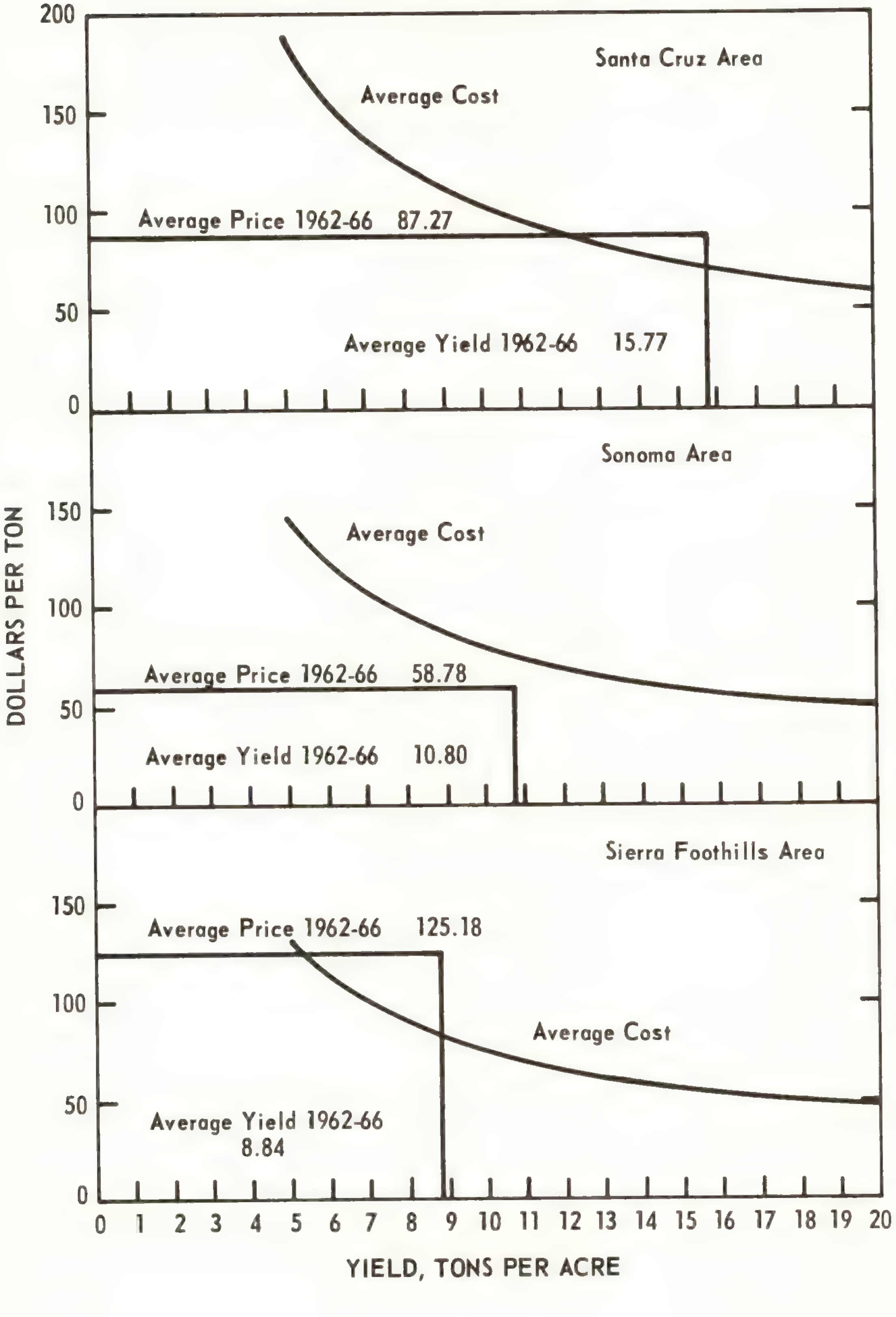
c/ Computed on the basis of 1962-1966 average yields of 15.77 ton/acre in Santa Cruz County, 10.80 tons/acre in Sonoma County, and 8.84 tons/acre in Nevada County.

d/ Prices received at first shipping point.

Source: Agricultural Extension Service Mimeographs, University of California [4], [19], and [21].

FIGURE 4

Average Price, Yield, and Cost of Production for Producing Apples in the Santa Cruz, Sonoma, and Sierra Foothills Areas, California, 1962-1966



probably are not incurring losses every year. Second, the average producer has been able to cover cash costs. Third, some producers maintain a small acreage as a minor portion of a diversified operation. Finally, apple orchards require a significant investment to establish and therefore tend to be a fixed asset. There are, however, at least two indicators which point to a decline in Sonoma area acreage. These include, first, decreases in new plantings and nonbearing acreage and, second, the comparatively old age distribution of Gravenstein trees--Gravensteins being the major variety grown in the Sonoma area. It should be noted that there are above average producers in the Sonoma area who are making money growing apples. Their returns, however, would probably be higher for a comparable operation in another area.

Trends in Costs

Prices paid by farmers for production inputs, as measured by the Index of Prices Paid by Farmers, increased 11.3 percent from 1961 to 1966 (Table 10). Prices paid by California apple producers increased faster than the national average, especially in the Santa Cruz area. Changes in production costs by major expenditure groups for Santa Cruz County, Sonoma County, and the United States are shown in Table 10. Increased wage rates for hired labor were the main factors contributing to a 53-percent increase in Santa Cruz production costs between 1961 and 1967. Rates for hand labor increased 32 percent from $1.33 to $1.75 per hour. Workman's compensation insurance and Social Security payments were responsible for $.07 of this increase. Machine operator and supervision labor rates also increased from $1.59 per hour to $2.18 per hour for a 37-percent increase. The increased cost per acre was affected most by pruning, thinning, and harvesting--operations requiring large amounts of hired labor. The costs of these three operations increased 71 percent in Santa Cruz County and 10 percent in Sonoma County as compared to a U.S. Department of Agriculture's Index of Wages Paid Farm Laborers' increase of 22 percent. Hours per acre required to produce apples have decreased but not enough to offset the increased wage rates. Less thinning of processing apples combined with lower yields in Sonoma County accounted for its small increase in labor costs.

Input costs have remained relatively constant during the last six years as shown by the small increase in the Index of Prices Paid for Farm Supplies (Table 10). Increased use of spray and fertilizer was primarily responsible

TABLE 10

Changes in Average Cost of Production of Apples by Cost Item for Santa Cruz and Sonoma Counties, California, Compared to Average Cost Changes for the United States

Cost item	Cost per acre[a]				Change in costs		
	Santa Cruz		Sonoma		Santa Cruz	Sonoma	U.S.
	1961	1967	1962	1966	1961-1967	1962-1966	1961-1966
	dollars				percent		
Labor[b]	266	453	275	302	70.3	9.8	25.0[c]
Inputs[d]	73	95	105	68	30.1	-35.2	3.0[e]
Land	11,200	1,500	1,000	1,500	25.0	50.0	34.0[f]
Investment[g]	1,030	1,405	795	1,126	36.4	41.6	--
All costs[h]	758	1,159	768	887	52.9	15.5	11.0[i]

[a] Based on yields of 18 tons per acre in Santa Cruz County and 15 tons per acre in Sonoma County.

[b] Labor cost consists of wages paid for pruning, thinning, and picking.

[c] From the Index of Wages Paid to Farm Laborers [30, p. 2].

[d] Cost of spray and fertilizer.

[e] From the Index of Prices Paid for Farm Supplies [30, p. 2].

[f] U.S. Department of Agriculture, Economic Research Service [31].

[g] Includes investment in trees and equipment.

[h] Includes all cash costs plus depreciation and a 6-percent charge for invested capital.

[i] From the Index of Prices Paid by Farmers [29, p. 6].

for a 30-percent increase in input costs in Santa Cruz County. Sonoma County producers spent less for spray and fertilizer in 1966 than in 1962.

Investment costs in land and trees continue to grow with increasing land values and higher interest rates. Data in Table 10 indicate that the increase in costs of land suitable for apple production in California has averaged about the same as the U.S. increase. In 1966, however, the average value per acre of farm real estate in California was over 20 percent higher than the U.S. average.[1] At the same time, California real estate values were 40 percent higher than Washington and Oregon. California's population pressures assure continued increases in land values. For those producers owning land, this has no effect on cash costs. It is important, however, to California's competitive positions in apple production and to decisions to plant new orchards or pull out existing orchards.

Comparison of Costs

California's principal competition in the higher valued fresh market outlets comes from Washington and Oregon. The future may also bring increased competition from these states in the processed outlet. It is, therefore, useful to see how California compares with these states in terms of costs of production, average yield, and returns per acre. Comparable data for the three states are difficult to obtain. Several assumptions together with considerable updating and revision enable comparable estimates for the three states to be made. Washington growers appear to have an advantage over those in California and Oregon in both net returns per ton and net returns per acre (Table 11). California's cost per acre as well as cost per ton is higher than the other states. Santa Cruz County's cost per ton compares favorably because of high average yields. The principal source of Washington's advantage lies in the higher average price per ton received by producers. Washington typically sells 85 percent of its crop in the fresh market. Both Oregon and Sonoma County show a net loss when all costs other than management are considered. Producers in both of these areas are, however, able to cover cash costs.

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[1] See U.S. Department of Agriculture, Economic Research Service, [31]. An index of average value per acre of farm real estate in 1966 gave the following numbers (1957-1959 = 100): United States, 150; Washington, 130; Oregon, 131; and California, 171.

TABLE 11

Estimated Costs and Returns for Producing Apples in California, Oregon, and Washington

Item	California[a]		Oregon[b]	Washington[c]
	Santa Cruz	Sonoma		
	dollars			
Total cost/acre[d]	1,121.88	867.34	701.50	843.80
Total cost/ton[e]	71.14	80.31	67.19	70.43
Average price/ton[f]	87.27	58.78	62.40	95.20
Net returns/ton	16.13	- 21.53	- 4.79	24.77
Net returns/acre	254.37	-232.52	- 50.01	296.74

a/ California data is from Table 9.

b/ Data from Greene, Warren J., Arthur E. Irish, and D. Curtis Mumford [18]. Charges for depreciation of trees and interest on all investments were added to reported cost figures. This adjusted cost figure was then updated to 1966 cost by use of a table in the bulletin specifically designed for updating the cost figure.

c/ See Mitchell, John [20] and C. H. Zuroske [37].

d/ Includes all costs except a charge for operator's management.

e/ Average yields for 1962-1966 were as follows: Santa Cruz County, 15.77 tons per acre; Sonoma County, 10.80 tons per acre; Oregon, 10.44 tons per acre; and Washington, 11.98 tons per acre. The figure for Oregon assumes a .609-ton per acre increase in yield since 1957. The yield for Washington is based on 473 packed boxes per acre.

f/ Average price received for all uses, 1962-1966.

CALIFORNIA APPLE CONSUMPTION

Utilization for Processing

California typically processes a larger proportion of its annual apple crop than does any of the other major apple producing states. This is due, in part, to the high proportion of California production in processing varieties. California processed an average of over 71 percent of its production during the five-year period, 1963-1967.[1] Several other states are also important apple processors. New York, Pennsylvania, Virginia, and Michigan have recently processed over half of their production. Washington, the leading fresh apple producer, typically processes only 10 to 20 percent of its crop.

The most recent figures available on U.S. apple utilization show that about 42 percent of the 1967 crop was processed and the other 58 percent was consumed fresh. Over time, the percentage processed has been increasing while the percentage consumed fresh has been decreasing. In 1952, about 28 percent of the crop was processed. This percentage figure increased to 35 percent in 1959 and is now over 40 percent. Processors tend to utilize larger percentages of the crop in large crop years and smaller percentages in small crop years. Their actions tend to prevent large year-to-year price movements in the fresh market.

The farm value of processed apples in California averaged over $9 million per year for the five-year period, 1963-1967. During this period, California processed 13.7 percent of total U.S. apples processed and these apples accounted for 15.5 percent of the total value of apples processed. Five states typically account for 70 to 75 percent of the total volume of apples processed. New York leads with approximately 22 percent of the processed apple supply. The other important processing states include California, Michigan with 14.0 percent, Pennsylvania with 12.0 percent, and Virginia with 9.0 percent of U.S. processed apple supplies.

Processed apples are canned, frozen, dried, and crushed. California is the only state with significant quantities utilized in each of the processed categories. Most states concentrate on canning and crushing while a few states, including New York, also freeze significant quantities of apples. California's most important processing use in value terms is canning. This is followed, in order of decreasing importance, by drying, crushing, and freezing. Year-to-year variation in crop utilization is caused both by quality factors and market demand as reflected in relative prices. Examination of each of the processing categories reveals California's relative importance in apple processing.

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[1] All utilization figures computed from U.S. Department of Agriculture, Statistical Reporting Service, [35].

Canned

The majority of apples canned in California are processed as applesauce. An average of 36 percent of the apples processed in California during the 1963-1967 period were canned. This compares with the U.S. average of 48 percent. The lower percentage figure for California is a reflection of the balanced nature of its processing industry rather than a lack of importance. During the 1963-1967 period, California canned approximately 10 percent of the apples canned in the United States. In quantity and value terms, this amounts to an average of 60,200 tons per year with an average farm value of $3.75 million.

Dried

Utilization of California apples for drying has dropped below 25,000 tons annually only two times since 1914. This occurred in the short crop years of 1948 and 1963. Approximately 21 percent of the apples processed in California from 1963-1967 were dried. The average farm value of these apples was approximately $1.87 million per year. California and Washington are the leading processors of dried apples in the United States. From 1963-1967, California processed an estimated 38 percent of the U.S. dried apple supply.

Crushed

Since 1963, approximately 27 percent of the apples processed in California have been crushed. Apples crushed for cider, vinegar, and juice typically fail to meet the standards for fresh or other processing use because of size, color, and/or blemishes. While a significant percentage of California's apples are crushed, the ratio is actually quite favorable when compared to the U.S.

average of 35 percent. Apples used for crushing return less per ton to growers than those canned, frozen, or dried. Crushing apples still returned an average of over $1.8 million annually to California producers from 1963-1967.

Frozen

Fewer apples are frozen in California than are processed in any of the other major utilization categories. Freezing has averaged 16 percent of average processing utilization since 1963. Almost 27,300 tons of apples per year with a farm value of just over $1.7 million have been frozen. Despite the comparatively small percentage utilization for freezing, California is of national importance in this category. During the 1963-1967 period, California processors froze an average of almost 26 percent of the annual U.S. frozen pack.

Fresh Consumption

The quantity of apples consumed fresh in the United States has been decreasing both on a per capita basis and as a percentage of total apple consumption. Average U.S. per capita consumption of fresh apples declined from 21.3 pounds in 1952-1953 to 16.1 pounds in 1965-1966 (Table 12). California data, interestingly enough, does not exhibit the same trends. California per capita consumption of fresh apples was 21.7 pounds in 1952-1953 and 21.1 pounds in 1965-1966.[1] Comparing the first five years in Table 12 with the last five reveals the extent of the differences in fresh consumption. From 1952-1956, Californians consumed 1.13 pounds per capita more than the U.S. average and from 1962-1966 they consumed 4.97 pounds more than the U.S. average. This shift in consumption makes California a very attractive fresh apple market. California accounted for 9.8 percent of the U.S. population in 1966 but Californians consumed approximately 12.0 percent of the fresh apples consumed in the United States.

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[1] Per capita consumption data for fruit are usually not available on a state or regional basis. The estimates for California were derived from border station data on truck shipments combined with rail and boat unload data and estimates of California production consumed fresh in California. These data probably slightly underestimate California consumption. California Border Stations discontinued their reporting service in the spring of 1967.

TABLE 12

Quantity of Apples Consumed Fresh in California by Source, Proportion Supplied by California and Per Capita Consumption of Fresh Apples in California and the United States, 1952-1966

Year	Quantity of apples consumed fresh in California by source		Proportion supplied by California	Per capita consumption of fresh apples	
	California a/	Other b/		California c/	U.S. d/
	tons		percent	pounds	
1952-1953	55,662	73,160	43.2	21.7	21.3
1953-1954	31,127	94,349	24.8	20.4	20.5
1954-1955	46,199	94,546	32.8	22.1	19.8
1955-1956	49,315	97,383	33.6	22.1	19.3
1956-1957	51,791	79,770	39.4	19.0	19.1
1957-1958	52,890	125,608	29.6	24.7	20.9
1958-1959	54,005	117,112	31.6	22.8	21.8
1959-1960	52,250	110,946	32.0	21.0	19.7
1960-1961	46,773	100,499	31.7	18.2	17.3
1961-1962	56,400	107,256	34.5	19.5	16.9
1962-1963	66,174	125,411	34.5	22.1	17.1
1963-1964	49,085	154,685	24.1	22.7	17.3
1964-1965	81,049	140,400	36.6	24.0	17.1
1965-1966	69,716	130,478	34.8	21.1	16.1

a/ As estimated in California Department of Agriculture, California Crop and Livestock Reporting Service [6] and [7].

b/ Data on apples shipped into California by truck [14]. Rail and boat data [15] and [28].

c/ Based on estimated California population, January 1, California Department of Finance [8].

d/ Each of the entries for the United States is a two-year average of per capita fresh apple consumption [32, August, 1968].

There are several factors which might be used to explain the shifts in fresh apple consumption noted above. These include relative incomes, prices, tastes and preferences, and urbanization. A regression equation utilizing a ratio of per capita consumption as the dependent variable and relative incomes, prices, and trend as independent variables was estimated. Relative income was a nonsignificant variable and added little to the explanatory power of the equation. It was dropped from the analysis and the following equation was estimated

$$Y = .837 + \underset{(.095)}{.111}\, X_1 + \underset{(.005)}{.024}\, T \qquad (6)$$

$$R^2 = .67 \qquad S_y = .083$$

where

Y = California per capita consumption divided by U.S. per capita consumption,

X_1 = Eastern fresh price divided by Western fresh price (farm level), and

T = trend with 1952-1953 = 1, 1953-1954 = 2, . . . , 1965-1966 = 14.

Standard errors of the variables are shown in parentheses. One would expect the ratio of California to U.S. fresh consumption to increase as the ratio of Eastern to Western fresh prices increases. While the coefficient for the price variable is not significant at the 5-percent level, it does have the expected sign. The trend variable is quite significant indicating that there has been a uniform increase in the consumption ratio over time. A brief examination of the factors considered helps to explain the results.

Prices

The ratio of Eastern fresh price to Western fresh price ranged from .91 to 1.71. These prices do not include marketing margins but they are an indication of the level of retail prices in the West (primarily Oregon, Washington, Idaho, and California) relative to the rest of the United States. Western fresh prices were used since approximately two-thirds of the apples consumed fresh in California come from surrounding states. Perhaps a better estimate of the effect of differences in relative prices could be made if retail price data were available.

Tastes and Preferences

The trend variable was included in the equation to explain changes in the ratio of consumption which have occurred in a systematic manner over time. This type of change is typically attributed to changes in tastes and preferences. These changes in tastes and preferences could be due to many factors, including such things as advertising, promotion, and product availability.

Income

It is not surprising that the income variable in the initial formulation was nonsignificant. The ratio of California per capita income to U.S. per capita income exhibited very little variation. For 12 of the 14 years considered, it ranged from 1.21 to 1.23. Other studies show no clear-cut relationship between income and fresh apple consumption. William Tomek, in a New York study, included income as one of the variables studied [22, p. 14]. He substituted a trend variable for income after the income coefficient was found to have a negative sign. Cross-sectional data from the 1965 Food Consumption Survey adds little to our knowledge of the relationship between income and fresh apple consumption. These data indicate that per capita fresh apple consumption first increases and then decreases as income increases [27, p. 39].

Urbanization

Data from the 1965 Food Consumption Survey indicate that rural families eat more fresh apples than do urban families [27, pp. 81, 128, and 177]. Census data reveal that the United States is becoming more urbanized over time and that California is more urbanized than the U.S. average [25, pp. 1-29 to 1-37]. From 1950-1960, the percentage shift of population from the rural to urban category was approximately the same for California as for the United States.1/ Urbanization, then, is of little value in explaining the relative shift in consumption. Urbanization alone would indicate higher per capita fresh apple consumption for the United States than for California.

1/ California's urban population increased from 80.7 percent in 1950 to 86.4 percent in 1960. Comparable figures for the United States are 64.0 percent in 1950 and 69.9 percent in 1960 [25, pp. 1-29 to 1-37]. These percentage figures are based on the current rural-urban definitions.

Source of Fresh Apples

Approximately two-thirds of the fresh apples consumed in California are shipped in from neighboring states. The proportion of apples supplied by California has varied from a high of 43.2 percent in 1952 to a low of 24.1 percent in 1963 (Table 12). The 14-year average of the proportion of fresh apples consumed in California which were produced in California is 33.1 percent. Of the apples shipped to California during the years 1952-1966, Washington supplied 74.8 percent; Oregon, 10.3 percent; Idaho, 7.5 percent; Canada, 4.3 percent; Utah and Colorado, each 1.1 percent; and other states, 0.9 percent. Washington sales in California amounted to 16.8 percent of their total fresh sales during the period.

As a state, California is probably the most important fresh apple market in the United States in terms of the total quantity consumed. Per capita consumption of fresh apples has remained comparatively steady and the number of consumers is growing. At present rates of consumption, California producers, to maintain one-third of the California fresh market, will have to increase fresh sales one ton annually for each 300-person increase in California's population.

Out-of-State Fresh Shipments

In 12 of the 15 years from 1952-1966, California fresh apples sold in other states provided a higher net return to producers than did those sold in California. The average premium during this period was approximately 16 cents per bushel for a margin of 7.7 percent [34, p. 7, 1961; p. 4, 1966].

The continued existence of a premium price for out-of-state sales of California fresh apples is difficult to explain other than on a quality basis. Out-of-state buyers may purchase a higher quality apple than the average sold in California. Otherwise, one would expect the industry to allocate sales in a manner that would tend to equalize returns for sales in and out of California. To maximize grower returns in this manner, the quantity of fresh apples sold out of state would be increased until producer returns for these apples equaled returns for those sold in California. There is little evidence that this type of allocation has been occurring. A premium price for out-of-state shipments existed in each of the years from 1958-1966 while the quantity shipped trended downward. Although the downward trend in out-of-state shipments has been interrupted at several points, it is quite pronounced and shows no signs of reversal. Shipments in 1965 were less than one-fourth of their 1952 level (Table 13).

A brief analysis of the pattern of out-of-state shipments of California fresh apples over time by type of carrier and destination gives some insight into what has occurred. Both rail and truck shipments have declined over time. Boat shipments depend on the nature of the export market and have been quite variable from year to year. The decline in rail shipments is almost complete. In the 1952 marketing season, there were 703 carlots of fresh apples shipped out of California by rail (Table 13). This accounted for approximately half of the out-of-state shipments. For the period 1963-1965, annual rail shipments averaged eight carlots. While the decline of out-of-state truck shipments of apples is not as dramatic, it is significant. Truck shipments went from a high of 713 carlots in 1953 to 297 carlots in 1965. The pattern of truck shipments over time by destination is partially indicative of what has been happening. The only out-of-state markets that California apple producers have maintained over time are in Nevada and New Mexico (Table 14). Truck shipments to Arizona, Texas, other states, and Canada have declined significantly over time.

If any pattern is apparent from the data, it is that California has not been able to compete with other fresh apple producing areas in distant markets. This is demonstrated first by the decline in rail shipments, the typical mode of transportation for long-distance shipments. The decline in truck shipments to the more distant states lends further support to the conclusion. While this loss of out-of-state markets is largely due to increased competition, other factors bearing on the problem must also be mentioned. Controlled atmosphere storage has lengthened the marketing season for the preferred red varieties of apples and they are now available almost year around.[1/] Other producing areas, such as North Carolina, are now producing significant quantities of early apples. Both of these factors tend to decrease the demand for California summer varieties for fresh consumption.

[1/] A survey of homemakers' attitudes about fresh apples stated that, "When looking for fresh apples for eating raw, most homemakers want apples that are red (underline added), juicy, unblemished, not bruised, of medium size, firm but not hard, and sweet." Delicious varieties were preferred in the West, South, and North Central states and McIntosh were preferred in the Northeast [10, p. 12].

TABLE 13

Out-of-State Shipments of California Fresh Apples by Type of Carrier, 1952-1966

Year[a]	Type of carrier			
	Truck	Rail	Boat	Total
	carlots[b]			
1952-1953	668	703	50	1,421
1953-1954	713	293	52	1,058
1954-1955	664	289	18	971
1955-1956	727	334	43	1,104
1956-1957	591	66	42	699
1957-1958	774	85	30	889
1958-1959	693	77	3	773
1959-1960	477	19	38	534
1960-1961	471	28	40	539
1961-1962	380	28	56	464
1962-1963	335	22	68	425
1963-1964	257	5	27	289
1964-1965	311	11	51	373
1965-1966	297	8	7	312

a/ Crop-year basis, June 1 to May 31.

b/ One carlot equals 16.4 tons.

Source: Truck data from Federal-State Market News Service [14]. Rail and boat data from Federal-State Market News Service [13].

TABLE 14

Out-of-State Truck Shipments of California Fresh Apples by Destination, 1952-1966

Year[a/]	Destination				
	Arizona	Nevada	New Mexico	Texas	Other U.S. and Canada
	carlots[b/]				
1952-1953	231	54	30	180	173
1953-1954	230	56	51	234	142
1954-1955	214	66	53	185	146
1955-1956	201	51	48	250	177
1956-1957	212	49	38	176	116
1957-1958	277	62	36	257	142
1958-1959	252	69	40	190	142
1959-1960	157	57	51	127	85
1960-1961	186	58	46	70	111
1961-1962	147	43	41	56	93
1962-1963	120	59	36	45	75
1963-1964	96	59	35	35	32
1964-1965	111	69	43	34	54
1965-1966	96	74	64	33	30

a/ Crop-year basis, June 1 to May 31.

b/ One carlot equals 16.4 tons.

Source: Federal-State Market News Service [14].

Prices of California Apples

Two aspects of California apple prices will be examined. First, a comparison of average prices between the fresh and processing outlets both in California and in the United States will be made. Second, the price determinants of fresh and processing apples in California will be discussed.

Price Comparisons

Apples sold for fresh consumption return much more to producers than those utilized for processing. The average U.S. fresh price from 1963-1967 was $120.08 per ton while the average processing price was $47.72 per ton [33] and [34]. Since California processes a larger percentage of the crop than does any other major producing state, its overall average price is typically below the U.S. average.

California producers typically receive more for apples utilized for processing than do producers in other states. From 1963-1967, California processing apples returned an average of $8 per ton more than the U.S. average. In percentage terms, this premium amounted to just over 16 percent [33] and [34]. The existence of this premium is due to several factors. These include: (1) Processing is the major outlet for California apples and not a disposal or secondary outlet as it is in some states. (2) Gravensteins are noted for their superior processing qualities and are produced primarily for processing. (3) California processors produce a wide variety of processed products as contrasted to processors in some states who process only sauce and juice.

California apples sold for fresh use typically return less than the U.S. average price to producers. For the 1963-1967 period, the differential was approximately 66 cents per bushel. Possible explanations for this differential include, but are not limited to, the following factors: (1) Two of the major varieties produced in California (Gravensteins and Newtons) are preferred for processing but are not widely accepted for fresh consumption. (2) The fresh varieties produced in some production areas do not normally develop the same degree of color as those produced in the Northwest. Lack of red color can result in a discount since consumers have expressed a preference for "bright or deep red apples" [10, p. 12]. (3) California apples have not been promoted to wholesalers, retailers, and consumers as have apples from other producing areas.

Price Determinants

Economic theory suggests several factors which may influence the price of apples. These include the quantity of apples produced, the number of consumers, prices and availability of competing products, consumer income, and consumer tastes and preferences. On an annual basis, the carry-over of processed apple products must also be considered. These price determinants were used to estimate price equations for both fresh and processing apples in California. An equation for average California apple prices (fresh and processed) was also estimated.

The estimated price equation for processing apples is

$$Y = .0232 - \underset{(.067)}{.2340}\,X_1 - \underset{(.007)}{.0215}\,X_2 - \underset{(.036)}{.0937}\,X_3 + \underset{(.0002)}{.00103}\,X_4 \qquad (7)$$

$$R^2 = .72 \qquad S_y = .0018$$

where

Y = farm level price (dollars per bushel) of California processing apples deflated by the Wholesale Price Index (1957-1959 = 100),

X_1 = California apple production (bushels), U.S. per capita,

X_2 = U.S. minus California apple production (bushels), U.S. per capita,

X_3 = quantity (bushels) of processed apple products in stock on June 1, U.S. per capita, and

X_4 = U.S. per capita disposable income deflated by the Wholesale Price Index (1957-1959 = 100).

Standard errors of each of the variables are shown in parentheses. All of the variables are significant at the 5-percent level. The independent variables considered explain 72 percent of the variation in the price of California processing apples. The standard error of estimates is shown by S_y. A variable for per capita consumption of competing fruits was considered but dropped from the analysis when it added little to the explanatory value of the equation. The equation states that the California processing price varies inversely with apple production and directly with per capita disposable income.

The estimated price equation for fresh apples is

$$Y = .0613 - \underset{(.008)}{.0409} X_1 - \underset{(.065)}{.1455} X_2 - \underset{(.00003)}{.00014} X_3 - \underset{(.022)}{.0362} X_4 \qquad (8)$$

$$R^2 = .804 \qquad S_y = .0028$$

where

Y = farm level price of California fresh apples deflated by the Wholesale Price Index (1957-1959 = 100),

X_1 = U.S. apple production (bushels), U.S. per capita,

X_2 = Western stocks of frozen apples (pounds), September 1, U.S. per capita,

X_3 = production of table grapes in California (pounds), California per capita, and

X_4 = production of Delicious apples in California (bushels), California per capita.

Standard errors of the variables are shown in parentheses. With the exception of X_4, all of the variables are significant at the 5-percent level. As expected, the price of California fresh apples varies inversely with production of all apples, with stocks of frozen apples, and with production of California table grapes and Delicious apples. The majority of California apples consumed fresh are of the Delicious variety. Variables which were considered during the analysis but not included in the estimated price equation included Washington apple production, total California apple production, Western States apple production, carry-over of processed products, production of peaches and pears, production of oranges in California, and consumer income.

Efforts to estimate an equation for the average price of all California apples were not as successful as those for fresh apples and processing apples (Equations (7) and (8)). The estimated price equation for all California apples is

$$Y = .0372 - \underset{(.062)}{.1318} X_1 - \underset{(.008)}{.0210} X_2 - \underset{(.00005)}{.000078} X_3 \qquad (9)$$

$$R^2 = .574 \qquad S_y = .0023$$

where

Y = farm price of all California apples deflated by the Wholesale Price Index (1957-1959 = 100),

X_1 = California production of apples (bushels), U.S. per capita,

X_2 = U.S. minus California production (bushels), U.S. per capita, and

X_3 = U.S. per capita consumption of fresh oranges, bananas, and pears (pounds).

The variables for apple production in California and the United States were significant at the 5-percent level. The average price of California apples varies inversely with production of apples in California and in the United States as well as with production of competing fruit. Other variables, which were considered but were not statistically significant, included per capita income and carry-over of processed apple products.

The three price equations can be used to forecast prices when estimates of the independent variables are available. Average fresh apple prices can be forecast, for instance, when one has estimates of U.S. apple production, September 1 Western stocks of frozen apples, California production of table grapes, and California production of Delicious apples.

CALIFORNIA APPLE STORAGE

As a major producer of summer apples, California has a comparatively long time period when it can market fresh apples without refrigerated storage. This harvest period typically ranges from June to November. To supply the highest quality fresh apple after this harvest period, however, requires refrigerated storage. Controlled atmosphere[1/] storage now permits the marketing of fall and winter varieties the following spring and summer with no appreciable loss in quality.[2/] Fresh apple packers in other states have found that if they want to service food chain stores they must be prepared to pack large volumes of uniform quality apples over the majority of the sales period [9, p. 8]. This has been an important factor in the rapid expansion of CA storage facilities in the leading fresh apple producing states [11, p. 35].

[1/] Controlled atmosphere will hereafter be abbreviated to CA.

[2/] For an excellent summary and discussion of the development and use of CA storage, see Dalrymple, Dana G. [11].

Fresh apples in California are stored in common (unrefrigerated), refrigerated, and CA storage. California storage holdings on November 1, 1966 had an approximate distribution of 10.8 percent in common storage, 61.6 percent in refrigerated storage, and 27.6 percent in CA storage [11, p. 55].

Controlled atmosphere storage of apples in California was first reported in 1958 [11, p. 35]. As of November 1, 1966, California had approximately 879,000 bushels of apples in CA storage which represented about 6.6 percent of the total U.S. CA storage [11, p. 55]. It is important to note that even with the significant expansion of CA storage in California, the total quantity of apples stored has not increased and CA storage seems to have replaced, rather than added to, refrigerated storage capacity.

Most refrigerated storage, as expected, is located in the Santa Cruz area. Apples in refrigerated storage in Watsonville (located in the Santa Cruz area) have accounted for 82 to 91 percent of the California total (Table 15). The quantity of apples in refrigerated storage typically reaches a peak on October 31, November 15, or November 30 of each year [13, p. 22]. Data on the number of boxes of apples in refrigerated storage for the period 1950-1966 reveal two peaks. The first of these occurred in 1952 when 2,635,453 boxes were reported in storage and the second in 1966 when 2,621,810 boxes were reported in storage.[1]

It is difficult to estimate the proportion of apples sold fresh which are refrigerated since apples move in and out of storage during the harvest season. The peak amount in storage gives a minimum estimate of apples in refrigerated storage as a proportion of total sales and total fresh sales. The amount of apples in refrigerated storage as a percent of total sales has ranged from 14.8 percent to a little over 21 percent (Table 15). The quantity stored as a percent of fresh sales ranged from 49.8 percent to just over 80 percent.

The apparent stability of storage capacity combined with potential large increases in production of fresh varieties raises several questions which can have implications for the profitability of California apple production.

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[1] The Federal-State Market News Service does not specify the weight of a box of California apples. The weight is probably in the area of 36 pounds per box, thus a box of apples is approximately three-fourths bushel.

TABLE 15

Refrigerated Storage of California Apples as a Percentage of Total Sales and Total Fresh Sales, 1955-1967

Year	Stored[a/]	Stored in Watsonville	Storage	
			Total sales	Fresh sales
	bushels	percent		
1955	1,764,052	87.1	19.8	66.0
1956	1,861,912	85.2	21.5	75.6
1957	1,854,322	84.6	20.9	71.9
1958	1,755,757	86.6	19.8	66.5
1959	1,992,922	84.0	19.3	78.5
1960	1,739,685	91.2	19.8	71.7
1961	1,721,415	84.2	16.9	61.9
1962	1,627,500	88.0	15.1	51.9
1963	1,753,327	86.1	21.1	77.2
1964	1,816,560	88.8	14.8	49.8
1965	1,727,820	83.9	19.9	54.2
1966	1,966,357	82.0	22.6	63.3
1967	1,352,827	84.4	18.9	80.2

a/ Largest amount in storage on October 31, November 15, or November 30 of each year. Converted from box data; one box equals 36 pounds or three-fourths bushel.

Source: Storage figures from Federal-State Market News Service [13]. Sales data from U.S. Department of Agriculture, Statistical Reporting Service [35, annual issues, 1955-1967].

Projections

Functional relationships developed in previous sections of this report permit the construction of a simplified model of the California apple industry which can be used for making projections. The model is a historical statement of average relationships based on the economic structure of the industry during the period 1947-1967. This model forms a fairly self-contained basis for projection, given the assumption that there are no major changes in the economic structure of the apple industry.[1/]

The model consists of equations for California apple supply and demand.[2/] Estimated supply is derived by combining Equations (1), (2), and (3). Estimated planting from Equation (1) comes into bearing in seven years. The difference between planting in year t-7 and removals in year t (Equation (2)) is added to bearing acreage. Equation (3), (estimated yield) multiplied by bearing acreage, gives an estimate of production of California apples. This production estimate is then utilized in Equation (9) to estimate the price of California apples. The other three independent variables used in the price equation are determined outside the model. These include population, apple production in states other than California, and per capita consumption of competing fruit.

Each of the equations utilized in the model explains only a portion of the variation in the variable being examined. To test the ability of the model to predict changes in production and prices, known values of the relevant variables are inserted and the model is started operating. Actual prices for the 1946, 1947, and 1948 seasons together with the Index of Prices Paid by Farmers determine 1949 plantings. These plantings reach bearing age in 1956. The model is tested using both actual yields and a smoothed five-year moving average of yields. Results of the test of the model are shown in Figures 5 and 6. Estimated production is below actual production for the period tested. This is due to two factors. First, the model predicted more of a decrease in bearing acreage than occurred and, second, the five-year moving average of

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[1/] The State Marketing Order for California Apples includes a provision for advertising and promotion. If successful, this will result in a change in the economic structure of the industry.

[2/] Ben C. French used a more complete model than developed here for examining long-term prices and production of apples in the United States and Michigan [16].

FIGURE 5

Production of California Apples, Actual Values Compared with Model Estimates, 1956-1967

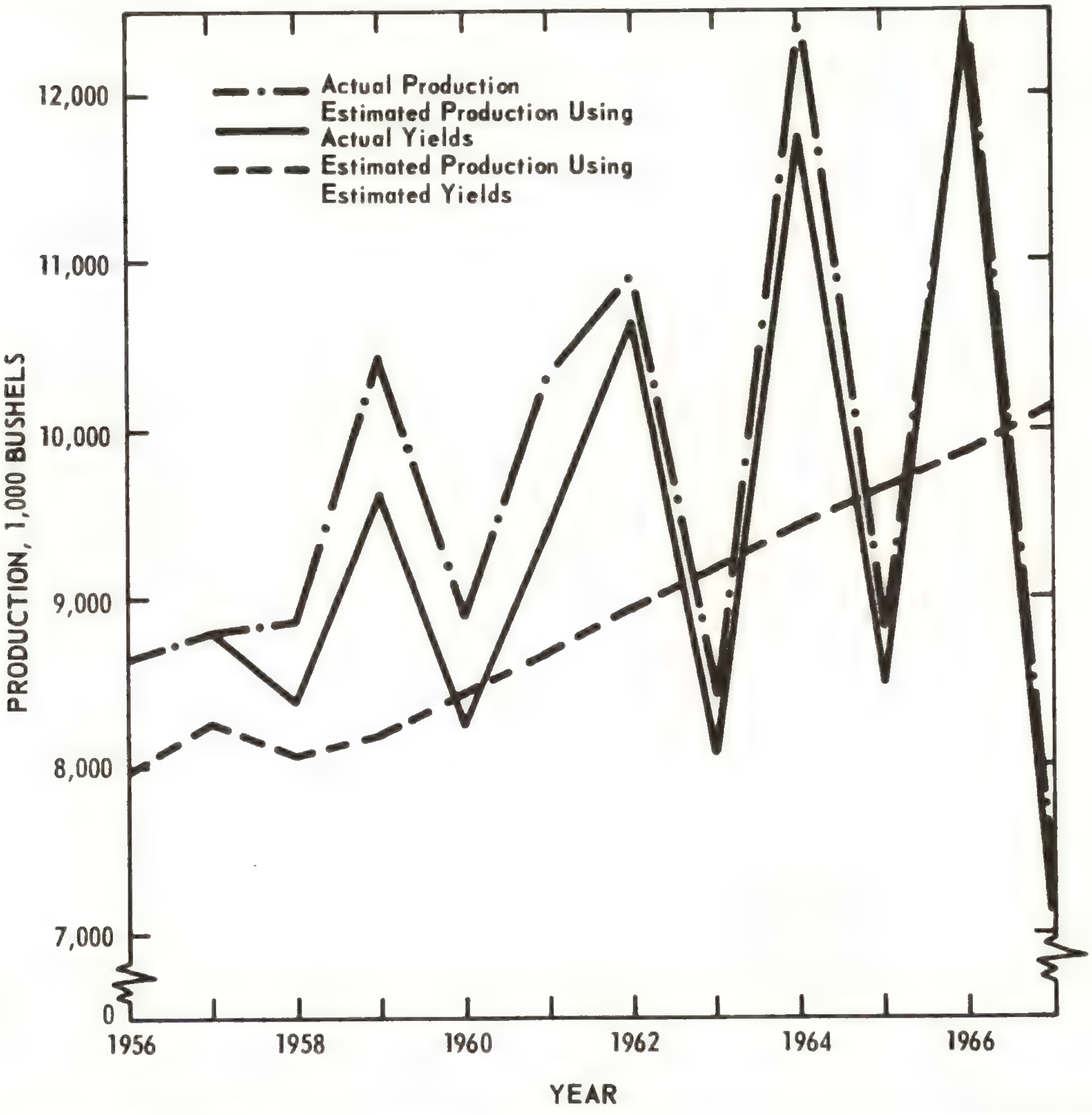
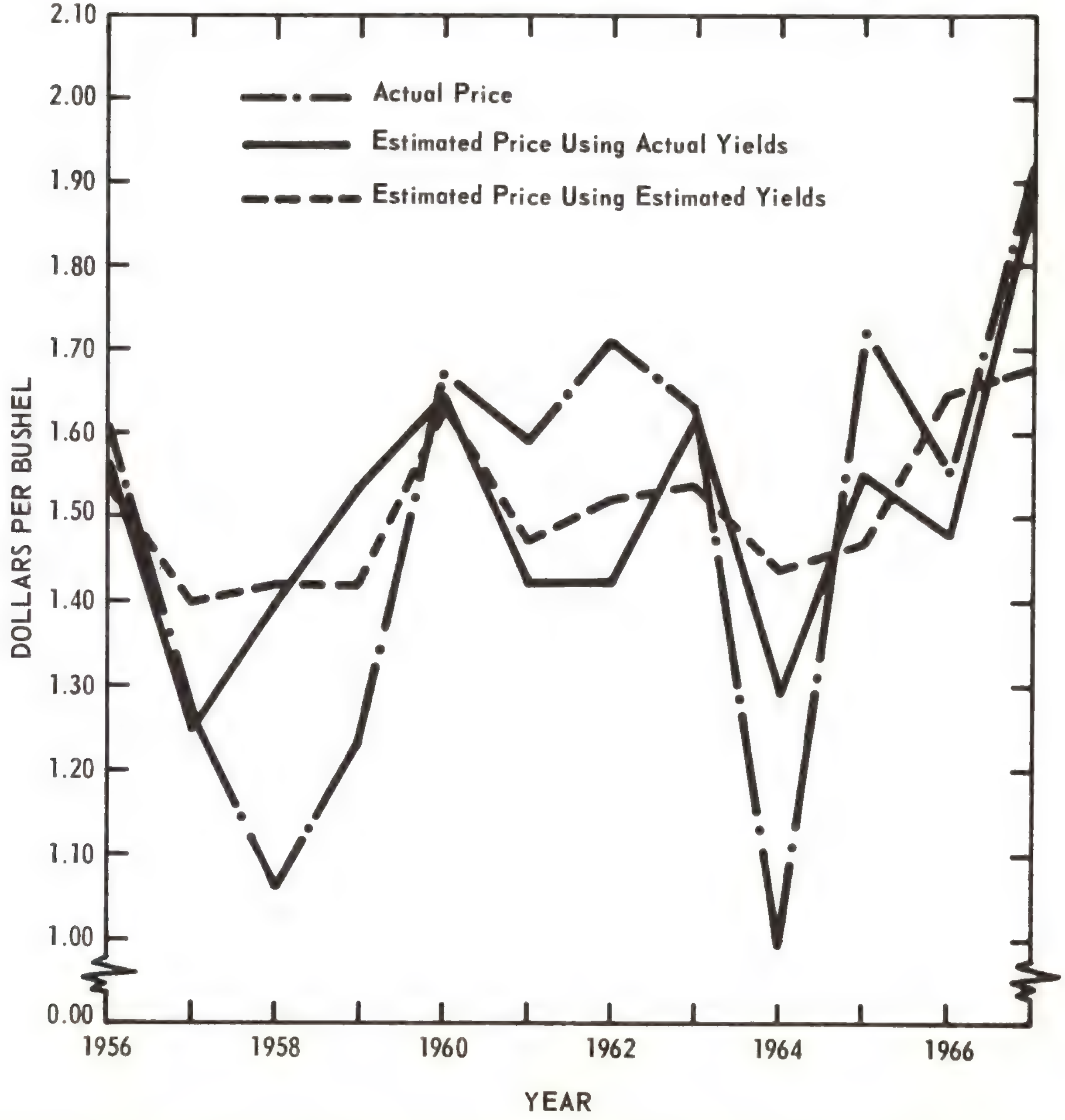


FIGURE 6

Price of California Apples, Actual Values Compared with Model Estimates, 1956-1967



yields tends to be below actual yields when actual yields are trending up. There is marked variation between actual and estimated prices of California apples. This is due to the importance of production in other states as a determinant of California prices. The estimated price using estimated yields appears to be an acceptable indicator of the average level of prices.

It should be emphasized that this model is a very simplified expression of the California apple industry. It predicts what will happen in the industry in average terms without accounting for the impact of year-to-year fluctuations in yield. The model does, however, show the major economic relationships existing in the industry and from this standpoint it can be used to evaluate the impact of various conditions. Projections of production and prices to 1980 will be made under three sets of conditions. The alternative conditions have no effect on production until 1975 since data on new planting and prices are available through 1967. The impact on price is immediate due to the importance of conditions outside California. Specifications for each of the projections follow.

Projection 1: Per capita production of states outside California remains at the most recent five-year average of .6148 bushels. United States population projection is Series B as estimated by the U.S. Bureau of the Census [23, p. 35]. The Series B projection assumes 3.100 children born per woman. The estimated population for 1980 is 243,291,000 persons. Per capita consumption of competing fresh fruit (oranges, pears, and bananas) remains at the most recent five-year average of 35.08 pounds. Advertising and promotion of California apples has no effect on their price. The projection is in 1967 prices.

Projection 2: Per capita production of states outside California increases to a level of .7890 bushels in 1980. This is in line with recent estimates of U.S. production of 173.7 million bushels in 1975 [2, p. 17]. Other specifications are the same as Projection 1.

Projection 3: Specifications are the same as Projection 1 with the exception of advertising and promotion. Price is increased 10 percent over what it would otherwise be due to advertising and promotion as authorized in the State Marketing Order for California apples.

Projections utilizing the model as specified are shown in Figures 7 and 8. Several important observations can be made. Bearing acreage for each of the projections is approximately the same in 1980. Projection 1 has 20,350

FIGURE 7

Projection of Average Level of Production of California Apples

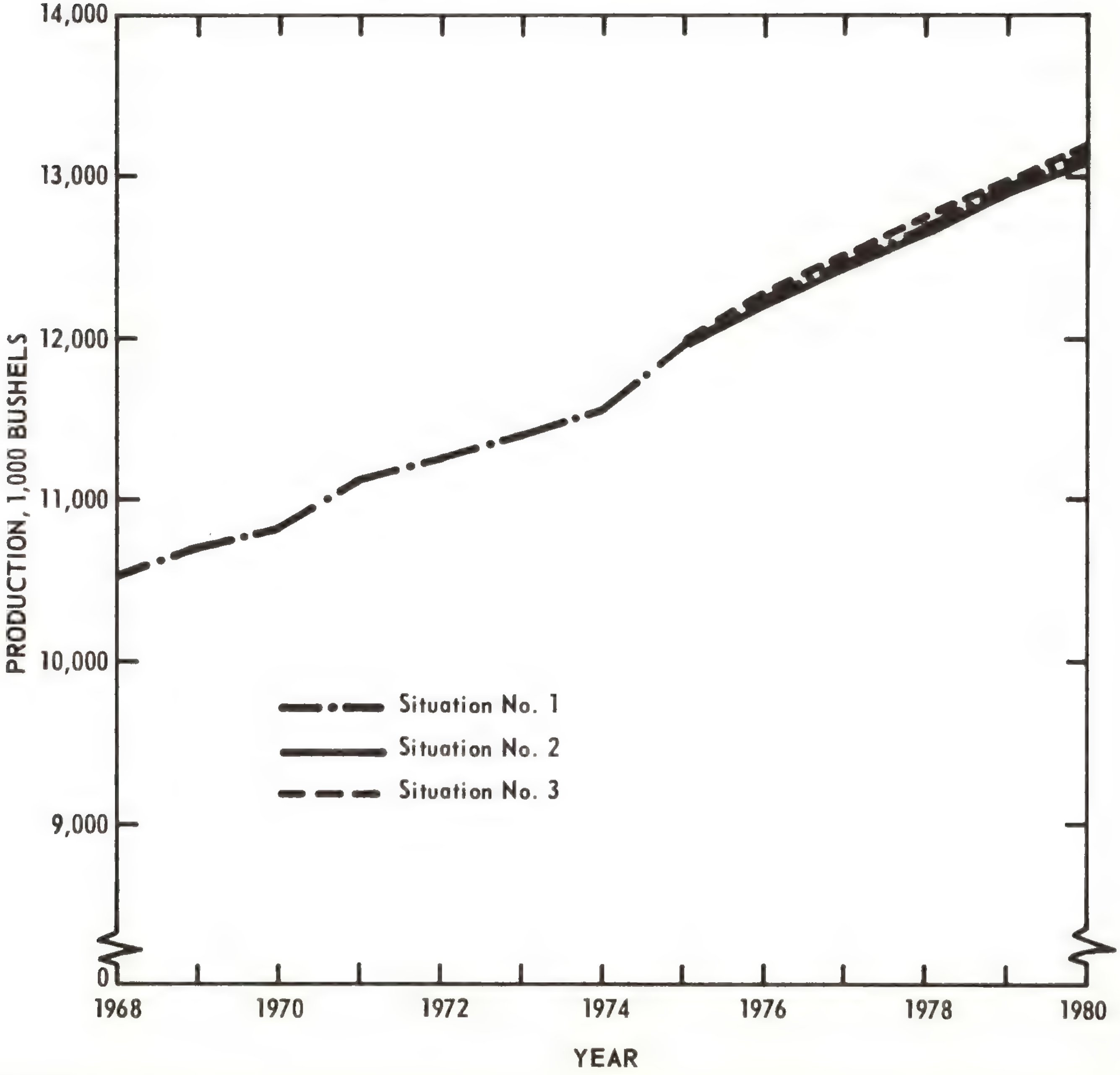
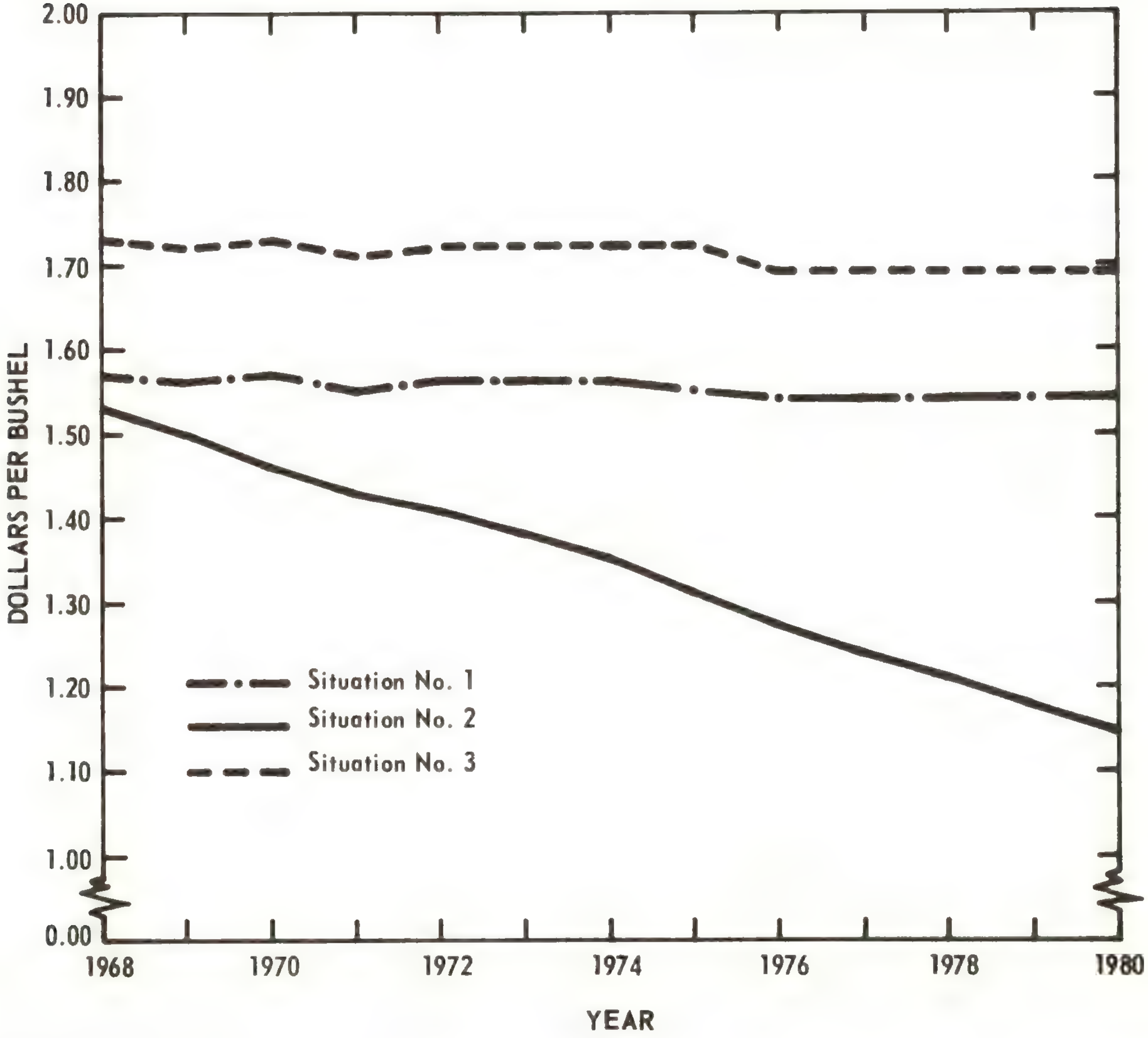


FIGURE 8

Projection of Average Level of Prices of California Apples



acres, Projection 2 has 20,299 acres, and Projection 3 has 20,430 acres. This is a decrease of approximately 1,000 acres from the present level. The increase in production is due to the upward trend in average yields. Note that there is very little production response to either high or low prices.

What happens to California prices is largely determined outside of California. There is only a one- to three-cent per bushel price change associated with the changes in California bearing acreage as projected between 1975 and 1976. Figure 8 does illustrate the severe impact on prices of increased per capita production in other states.

Research Needs

Relatively little economic research has been done with the California apple industry. Thus there is a real opportunity to adapt research results from other areas to California conditions. This is especially true in the area of storage and packing for the fresh market. Research topics in the area of packing and storage include work on economies of size, costs of alternative technologies, and determination of the optimum number and size distribution of firms.

With the adoption of a State Marketing Order, the California apple industry seems committed to a program of market development as well as research. The market development, if successful, will lead to increased demand for apples utilized in the fresh and processed outlets. This raises questions concerning the optimum time of marketing and potential storage requirements. For example, "Will it be profitable to increase refrigerated storage capacity and, if so, by how much?"; "What proportion of the fresh varieties can be profitably sold for fresh use?"; "How should fresh sales be allocated over the marketing season?"; and "What type and size of storage units should be constructed if more storage is necessary?". When answering these questions, one must consider production trends in competing states and their possible competitive responses.

SUMMARY

California is an important apple producing state, usually ranking fourth in production. Apples are produced in 48 of California's 58 counties. Three-fourths of the State's bearing acreage, however, is concentrated in the Watsonville area of Santa Cruz County and Sebastopol area of Sonoma County. The average annual farm value of California apple production from 1963-1967 was $15.01 million.

California had 21,450 bearing acres of apples in 1967. Equations explaining new plantings of apple trees and removals were estimated. The major determinant of planting is a three-year measure of profitability. Removals are a function of bearing acreage and have been trending upward over time. Equations estimating the yield of California apples indicate that average yield is trending upward at the rate of 12.48 bushels per year.

Data collected in connection with the State Apple Marketing Order Referendum conducted during the fall of 1967 show that there were approximately 1,440 apple producers in 1966. Of these, 796 producers were classified as commercial producers with sales of over 15 tons of apples. These producers sold 98.8 percent of the 1966 crop. Average sales by a commercial producer in 1966 were 307.9 tons. Over 92 percent of commercial production was accounted for by 48.24 percent of the producers.

Three varieties of apples account for over two-thirds of California production. Newtons (28 percent) and Gravensteins (18 percent) are best suited for processing. Red Delicious (23 percent) are best suited for fresh consumption. Red and Golden Delicious varieties now account for 33.5 percent of bearing and 52.7 percent of nonbearing acreage. Production of the Delicious varieties should increase in the future.

There is significant variation in per acre costs of production between different apple producing areas in California. Average costs of production range from $1,121.88 per acre in Santa Cruz County to $735.07 per acre in Nevada County. The average producer makes a profit in Nevada and Santa Cruz counties and incurs a loss in Sonoma County. Comparable data show that the average Oregon producer incurs a loss while the average Washington producer makes a profit.

California typically processes a larger proportion of its annual apple crop than does any of the other major apple producing states. Processed apples are canned, frozen, dried, and crushed. California is the only state with significant quantities utilized in each of the processed categories. California is an attractive market for fresh apples even though the percentage of its crop utilized fresh is comparatively small. California accounted for 9.8 percent of the U.S. population in 1966 but Californians consumed approximately 12.0 percent of the fresh apples consumed in the United States.

A comparison of average prices of apples between the United States and California reveals that California's price is higher for processing apples and lower for apples utilized fresh. Price determinants of California apples were examined and equations for processing apple prices, fresh apple prices, and the average price of all apples were estimated.

An examination of storage data revealed that storage capacity has been comparatively constant since 1955.

Functional relationships developed in the report were combined into a simplified model of the California apple industry. This model was then used to make projections under various sets of assumptions. The results indicate that bearing acreage of California apples will probably decline slightly by 1980 but that production should increase because of an upward trend in yields. The price level of California apples is largely dependent on what happens to production in other states.

The report concludes with suggestions on several topics of concern to the California apple industry which merit economic research.

APPENDIX

TABLE A-1

Average Farm Price of Apples, Production of Apples, Average Yield of California Apples, and Bearing Acreage and Plantings of California Apples, 1947-1967

	Average farm price of apples						Production			Yield of California apples[a/b/c/d/]			California acres[b/]	
	California[c/d/]			Western[e/f/]	United States[e/f/]		California[c/d/]		United States[g/]	All varieties	Delicious	Varieties other than Delicious	Bearing	Plantings
Year	Fresh	Processed	Average	Fresh	Fresh	Processed	All varieties	Delicious						
	dollars per bushel						1,000 bushels			bushels per acre			acres	
1947	1.03	.34	.70	1.36	1.76	.72	11,082	776	112,892	351	255	362	31,551	861
1948	1.47	.76	1.00	1.93	2.15	.76	5,870	470	89,330	204	161	209	28,809	400
1949	.87	.45	.62	1.05	1.37	.54	9,445	718	134,309	332	233	344	27,031	628
1950	1.43	.95	1.15	1.23	1.64	.81	6,748	576	123,769	247	160	261	25,940	396
1951	1.47	.81	1.10	2.13	1.94	.58	7,832	740	111,799	285	179	304	26,044	444
1952	2.00	.81	1.20	2.44	2.59	1.05	9,088	1,221	94,085	345	292	355	25,310	387
1953	3.05	1.47	1.85	2.55	2.62	1.50	7,088	832	95,778	291	179	319	23,791	424
1954	2.40	1.32	1.55	2.57	2.43	1.25	9,542	1,010	111,878	371	200	415	24,702	821
1955	2.05	.85	1.15	1.92	2.03	.83	9,440	1,356	106,263	375	271	402	24,137	699
1956	2.35	1.33	1.61	2.65	2.57	1.29	8,650	1,154	101,315	379	235	418	23,080	757
1957	1.95	.99	1.27	1.29	1.83	.83	8,800	1,698	119,258	390	325	409	23,043	796
1958	1.65	.81	1.06	1.48	1.87	.71	8,870	1,850	127,485	385	331	402	23,283	718
1959	1.95	1.00	1.23	2.32	2.38	.82	10,440	2,531	127,107	450	380	473	23,212	799
1960	2.59	1.31	1.67	2.81	2.92	1.17	8,890	2,161	108,705	387	360	397	22,954	675
1961	2.46	1.26	1.59	2.77	2.63	.92	10,300	2,419	126,725	443	378	468	23,226	939
1962	2.47	1.38	1.71	2.56	2.73	1.02	10,900	2,823	125,794	499	454	517	21,835	758
1963	1.91	1.46	1.63	1.94	2.48	1.16	8,400	2,261	126,420	378	350	389	22,223	631
1964	1.40	.84	.99	2.28	2.57	.88	12,400	3,421	138,910	553	512	570	22,437	754
1965	2.33	1.57	1.72	2.88	2.82	1.10	8,800	2,611	135,057	401	388	407	21,949	563
1966	2.13	1.35	1.55	2.66	2.90	1.16	12,400	3,521	126,460	580	507	616	21,365	457
1967	3.33	1.48	1.92	4.09	3.65	1.42	7,250	2,102	113,032	338	294	360	21,450	400

a/ Computed by dividing total production by bearing acreage.

b/ California Department of Agriculture, California Crop and Livestock Reporting Service [5].

c/ California Department of Agriculture, California Crop and Livestock Reporting Service [7].

d/ California Department of Agriculture, California Crop and Livestock Reporting Service [6].

e/ U.S. Department of Agriculture, Statistical Reporting Service [33].

f/ U.S. Department of Agriculture, Statistical Reporting Service [34].

g/ U.S. Department of Agriculture, Statistical Reporting Service [35].

TABLE A-2

Stocks of Apple Products, Per Capita Fresh Consumption of Competing Fruit, California Production of Table Grapes, Population, U.S. Per Capita Income, Wholesale Price Index, and Index of Prices Paid by Farmers, 1947-1967

Year	Stocks of apple products		Per capita fresh consumption of competing fruit[b][d]	California production of table grapes[e][f]	Population		U.S. per capita income[i]	Wholesale price index[i]	Index of prices paid by farmers[i]
	Processed June 1[a][b]	Western frozen September 1[c]			California January 1[g]	U.S. July 1[h]			
	1,000 bushel equivalents	1,000 pounds	pounds	1,000 tons	thousand		dollars	1957-1959 = 100	
1947	[j]	5,203	68.9	620	9,696	144,126	1,178	81.2	85
1948	[j]	2,252	62.5	592	9,948	146,631	1,290	87.9	95
1949	2,710	802	57.0	506	10,200	149,188	1,264	83.5	91
1950	5,419	489	51.9	588	10,490	151,684	1,364	86.8	94
1951	10,395	253	53.4	759	10,887	154,287	1,469	96.7	104
1952	7,501	253	52.9	648	11,384	156,954	1,518	94.0	104
1953	3,751	406	51.0	435	11,870	159,565	1,583	92.7	97
1954	5,175	446	47.1	482	12,309	162,391	1,585	92.9	97
1955	10,105	487	46.0	709	12,761	165,275	1,666	93.2	96
1956	9,707	1,938	44.3	453	13,293	168,221	1,743	96.2	95
1957	11,411	4,331	43.3	474	13,879	171,274	1,801	99.0	98
1958	10,938	6,223	38.3	530	14,459	174,141	1,831	100.4	100
1959	10,964	4,082	41.2	532	15,015	177,073	1,905	100.6	102
1960	12,206	2,528	42.4	560	15,576	180,684	1,937	100.7	101
1961	12,544	4,027	38.6	445	16,158	183,756	1,983	100.3	101
1962	12,517	3,169	34.5	578	16,748	186,656	2,064	100.6	103
1963	12,761	4,659	30.5	622	17,357	189,417	2,136	100.3	104
1964	13,452	4,598	33.5	517	17,940	192,120	2,280	100.5	103
1965	15,733	3,639	36.1	650	18,468	194,592	2,432	102.5	105
1966	18,775	7,147	37.1	560	18,933	196,920	2,598	105.6	108
1967	13,900	5,468	38.2	435	19,338	199,118	2,744	106.1	109

[a] Computed on the basis of one case of 24, 2-1/2 cans equal to 1.41 bushels and 1,000 pounds frozen apples equal to 48.958 bushels.

[b] U.S. Department of Agriculture, Economic Research Service [32].

[c] U.S. Department of Agriculture, Statistical Reporting Service [36].

[d] Consists of bananas, oranges, and pears.

[e] California Department of Agriculture, California Crop and Livestock Reporting Service [7].

[f] California Department of Agriculture, California Crop and Livestock Reporting Service [6].

[g] California Department of Finance [8].

[h] U.S. Bureau of the Census [25].

[i] U.S. Congress, Joint Economic Committee [26].

[j] Data not available.

LITERATURE CITED

[1] Bain, Beatrice M., and Sidney Hoos, *Apples--Fresh and Processed--Economic and Marketing Statistics*, Berkeley: University of California, Agricultural Experiment Station, Giannini Foundation of Agricultural Economics, May 1959, 45 pp.

[2] Brunk, Max E., Bennett A. Dominick, David A. Call, and Olan D. Forker, *Profile and Prospects in Apple Products, 1967-1975*, New York: report prepared for American Can Company, June 1967, 37 pp.

[3] Burlingame, Burt B., *California Apples Situation and Outlook: 1949*, Berkeley: California Agricultural Experiment Station, Circular 395, November 1949, 30 pp.

[4] Burlingame, Burt, and Edward Koch, *Apple Production Costs for Santa Cruz County*, Berkeley: University of California, Agricultural Extension Service, May 1967.

[5] California Department of Agriculture, California Crop and Livestock Reporting Board, *Acreage Estimates of California Fruit and Nut Crops - By Counties, 1919-1953*; *California Fruit and Nut Acreage, Bearing and Non-Bearing*, Sacramento, annual issues, 1954-1967.

[6] California Department of Agriculture, California Crop and Livestock Reporting Service, *California Fruit and Nut Crops, 1909-1955, Acreage, Production, Utilization, Value*, Sacramento, July 1956.

[7] California Department of Agriculture, California Crop and Livestock Reporting Service, *California Fruit and Nut Statistics, 1954-1967*, Sacramento, 1968.

[8] California Department of Finance, *California Population*, Sacramento, October 1967.

[9] Carman, Hoy F., and Dennis L. Oldenstadt, *The Changing Michigan Fresh Apple Packing Industry*, East Lansing: Michigan State University, Agricultural Experiment Station, Research Report 23, October 1964, 11 pp.

[10] Clayton, L. Yvonne, *Homemakers' Use of and Opinions About Selected Fruit and Fruit Products*, Washington, D.C.: U.S. Department of Agriculture, Statistical Reporting Service, Marketing Research Report No. 765, August 1966, 78 pp.

[11] Dalrymple, Dana G., *The Development of Controlled Atmosphere Storage of Fruit*, Washington, D.C.: U.S. Federal Extension Service, January 1967, 56 pp.

LITERATURE CITED (Continued)

[12] Dam, John Van, and Chester L. Hemstreet, *Roadside Apple Marketing Costs in San Bernardino County*, San Bernardino County: University of California, Agricultural Extension Service, 6 pp.

[13] Federal-State Market News Service, *Interstate Shipments of California Deciduous Tree Fruits*, San Francisco, annual issues, 1956-1966.

[14] Federal-State Market News Service, *Truck Passings of California Fresh Fruits and Vegetables Through California Border Stations*, Sacramento, annual issues, 1952-1966.

[15] Federal-State Market News Service, *Unloads of Fresh Fruits and Vegetables, Los Angeles, San Francisco, and Oakland*, Los Angeles and San Francisco, annual issues, 1952-1962.

[16] French, B. C., *The Long-Term Price and Production Outlook for Apples in the United States and Michigan*, East Lansing: Michigan State University, Agricultural Experiment Station, Technical Bulletin No. 255, April 1956.

[17] French, Ben C. and Raymond G. Bressler, "The Lemon Cycle," *Journal of Farm Economics*, Vol. 44, No. 4, November 1962, pp. 1021-1036. Giannini Foundation Paper No. 229.

[18] Green, Warren J., Arthur E. Irish, and D. Curtis Mumford, *Cost of Producing Apples and Pears in the Hood River Valley*, Corvallis: Oregon State University, Agricultural Experiment Station, Bulletin No. 573, May 1960.

[19] Hamilton, W. Douglas, and A. Doyle Reed, *Costs to Produce Apples in Nevada County*, Grass Valley: University of California, Agricultural Extension Service, November 1957.

[20] Mitchell, John, "Economies of Size of Apple Orchards in Central Washington," Pullman: Washington State University, unpublished Master's thesis, December 1967.

[21] Roberts, Kim O., and Burt B. Burlingame, *Apple Cost Study for Sonoma County*, Santa Rosa: University of California, Agricultural Extension Service, September 1966.

[22] Tomek, William G., *An Analysis of Changes in the Utilization of Apples in the United States*, Ithaca: Cornell University, Department of Agricultural Economics, A.E. Res. 137, December 1963, 43 pp.

LITERATURE CITED (Continued)

[23] U.S. Bureau of the Census, *Current Population Reports*, Series P-25, No. 388, "Summary of Demographic Projections," Washington, D.C., 1968.

[24] U.S. Bureau of the Census, *Current Population Reports*, Series P-25, No. 398, "Population Estimates," Washington, D.C., July 31, 1968.

[25] U.S. Bureau of the Census, *U.S. Census of Population: 1960. Number of Inhabitants, United States Summary, Final Report*, PC(1)-1A, Washington, D.C., 1961.

[26] U.S. Congress, Joint Economic Committee, *1967 Supplement to Economic Indicators*, Washington, D.C., 1967 and 1968.

[27] U.S. Department of Agriculture, Agricultural Research Service, *Food Consumption of Households in the United States, Spring 1965*, Washington, D.C., Report No. 1, 1968.

[28] U.S. Department of Agriculture, Consumer and Marketing Service, *Fresh Fruit and Vegetable Unloads in Western Cities by Commodities, States, and Months*, Washington, D.C., annual issues, 1963-1966.

[29] U.S. Department of Agriculture, Economic Research Service, *Demand and Price Situation*, Washington, D.C., May 1968.

[30] U.S. Department of Agriculture, Economic Research Service, *Farm Cost Situation*, Washington, D.C., November 1967.

[31] U.S. Department of Agriculture, Economic Research Service, *Farm Real Estate Market Developments*, Washington, D.C., (CD-1965-1969).

[32] U.S. Department of Agriculture, Economic Research Service, *Fruit Situation*, Washington, D.C., July and August issues, 1968.

[33] U.S. Department of Agriculture, Statistical Reporting Service, Crop Reporting Board, *Agricultural Prices, Supplement No. 1*, Washington, D.C., June 1968.

[34] U.S. Department of Agriculture, Statistical Reporting Service, Crop Reporting Board, *Agricultural Prices, Supplement No. 2*, Washington, D.C., July 1961 and July 1967.

[35] U.S. Department of Agriculture, Statistical Reporting Service, *Fruits, Noncitrus by States, Production, Use, Value*, Washington, D.C., annual issues, 1946-1967.

LITERATURE CITED (Continued)

[36] U.S. Department of Agriculture, Statistical Reporting Service, *Summary of Regional Cold Storage Holdings*, Washington, D.C., annual issues, 1947-1967.

[37] Zuroske, C. H., *Washington Apple Production Costs and Labor Requirements, 1960 and Earlier Years*, Pullman: Washington State University, Agricultural Experiment Station, Bulletin No. 644, October 1962, 16 pp.